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## 1.0 PROJECT OBJECTIVES

1.0.1 The project objective is to design and construct facilities for the military that are consistent with the design and construction practices used for civilian sector projects that perform similar functions to the military projects. For example, a Company Operations Facility has the similar function as an office/warehouse in the civilian sector; therefore the design and construction practices for a company operations facility should be consistent with the design and construction of an office/warehouse building.

### Comparison of Military Facilities to Civilian Facilities

| Military Facility      | Civilian Facility |
|------------------------|-------------------|
| Central Issue Facility | Warehouse         |

1.0.2 It is the Army's objective that these buildings will have a 25-year useful design life before a possible re-use/re-purpose or renovation requirement, to include normal sustainment, restoration, modernization activities and a 50-year building replacement life. Therefore, the design and construction should provide an appropriate level of quality to ensure the continued use of the facility over that time period with the application of reasonable preventive maintenance and repairs that would be industry-acceptable to a major civilian sector project OWNER. The site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles. The project site should be developed for efficiency and to convey a sense of unity or connectivity with the adjacent buildings and with the Installation as a whole.

1.0.3 Requirements stated in this contract are minimums. Innovative, creative, and life cycle cost effective solutions, which meet or exceed these requirements are encouraged. Further, the OFFEROR is encouraged to seek solutions that will expedite construction (panelization, pre-engineered, etc.) and shorten the schedule. **The intent of the Government is to emphasize the placement of funds into functional/operational requirements. Materials and methods should reflect this by choosing the most economical Type of Construction allowed by code for this occupancy/project allowing the funding to be reflected in the quality of interior/exterior finishes and systems selected.**

## 1.1 SECTION ORGANIZATION

This Section is organized under 6 major "paragraphs".

- (1) Paragraph 1 is intended to define the project objectives and to provide a comparison between the military facility(ies) and comparable "civilian" type buildings.
- (2) Paragraph 2 describes the scope of the project.
- (3) Paragraph 3 provides the functional, operational and facility specific design criteria for the specific facility type(s) included in this contract or task order.
- (4) Paragraph 4 lists applicable industry and government design criteria, generally applicable to all facility types, unless otherwise indicated in the Section. It is not intended to be all-inclusive. Other industry and government standards may also be used, where necessary to produce professional designs, unless they conflict with those listed.
- (5) Paragraph 5 contains Army Standard Design Criteria, generally applicable to all facility types, unless otherwise indicated in the Section.
- (6) Paragraph 6 contains installation and project specific criteria supplementing the other 5 paragraphs.

## 2.0 SCOPE

2.1 Construct a combined Central Issue Facility (CIF) for permanent party troops and soldiers in Advanced Individual Training (AIT).

Maximum number of permanent personnel assigned to a Large CIF is 30 – 40 persons.

The maximum gross area for this CIF is **94,101** square feet, based on provision of service for 15,001 – 22,000 troops.

Design requirements and assumptions include but are not limited to the following:

- (a) Assume the use of 5,000-pound capacity forklifts, with a turning radius of 12-feet, on the ramp, loading dock and all through the warehouse floor area.
- (b) Provide a three bay loading dock. Each bay shall be furnished with a 10 feet wide x 10 feet high overhead door for Receiving/Issuing operations. Door shall be electrically operated with manual over-ride. Provide a reinforced concrete edge guard along the edge of the loading dock as required. Concrete edge guard shall be minimum 1 foot wide and 1 foot high. Mount guardrails on top of concrete edge guard. Loading dock shall be furnished with all necessary dock accessories, including full-pit dock levelers, dock bumpers, fixed and removable safety railing, access stairs, etc.
- (c) Provide a forklift access ramp as one of the loading dock bays, as shown on the floor plan, included in Appendix J. Forklift access ramp shall be designed to provide required turning radius for the forklift described in paragraph 2.1(a). Forklift access ramp shall have a minimum width of 16 feet. Provide a reinforced concrete edge guard along the entire length on both sides of the ramp. Concrete edge guard shall be minimum 1 foot wide and 1 foot high. Mount guardrails on top of concrete edge guard. Access ramp shall be furnished with all necessary dock accessories, including fixed and removable safety railing, access stairs, etc.
- (d) Clear ceiling height (unobstructed clear height) in the warehouse area, including the issue/turn-in area, shall be 25 feet minimum.
- (e) Warehouse and issue/turn-in (back-up storage) area shall be designed free from obstruction by structural elements. However, if required, a maximum of one row of structural columns running along the centerline of the warehouse area in the long direction is acceptable. Design layout of the pallet rack system shall incorporate these columns as the centerline of one of the back-to-back rows of pallet racks.
- (f) Assume a male/female staff/soldier ratio of 80/20.
- (g) Assume that supply trucks are tractor-trailers hauling 53 feet long shipping containers.

The floor plan provided in Appendix J DRAWINGS, indicate functional and operational arrangements that meet user operability requirements.

## 2.2. SITE:

Provide all site improvements necessary to support the new building facilities. Refer to Paragraph 6.

Approximate area available 0.00 acres

## 2.3. GOVERNMENT-FURNISHED GOVERNMENT-INSTALLED EQUIPMENT (GFGI)

Coordinate with Government on GFGI item requirements and provide suitable structural support, brackets for projectors/VCRs/TVs, all utility connections and space with required clearances for all GFGI items. Fire extinguishers are GF/GI personal property, while fire extinguisher brackets and cabinets are Contractor furnished and installed CF/CI. All Computers and related hardware, copiers, faxes, printers, video projectors, VCRs and TVs are GFGI.

The following are also GFGI items: Vending Machines and Ice Maker.

## 2.4. FURNITURE REQUIREMENTS

Provide furniture design for all spaces listed in Chapter 3 and including any existing furniture and equipment to be re-used. Coordinate with the user to define requirements for furniture systems, movable furniture, storage systems, equipment, any existing items to be reused, etc. Early coordination of furniture design is required for a complete and usable facility.

The procurement and installation of furniture is NOT included in this contract. Furniture will be provided and installed under a separate furniture vendor/installer contract. The general contractor shall accommodate that effort with allowance for entry of the furniture vendor/installer onto this project site at the appropriate time to permit completion of the furniture installation for a complete and usable facility to coincide with the Beneficial Occupancy Date (BOD) of this project. The furniture vendor/installer contract will include all electrical pre-wiring and the whips for final connection to the building electrical systems however; the general contractor shall make the final connections to the building electrical systems under this contract. Furthermore, the general contractor shall provide all Information/Technology (IT) wiring (i.e. LAN, phone, etc.) up to and including the face plate of all freestanding and/or systems furniture desk tops as applicable, the services to install the cable and face plates in the furniture, the coordination with the furniture vendor/installer to accomplish the installation at the appropriate time, and all the final IT connections to the building systems under this contract.

The Government reserves the right to change the method for procurement of and installation of furniture to Contractor Furnished/Contractor Installed (CF/CI). CF/CI furniture will require competitive open market procurement by the Contractor using the Furniture, Fixtures and Equipment (FF&E) package.

## 2.5. NOT USED

### **3.0 FUNCTIONAL / OPERATIONAL REQUIREMENTS**

#### **3.1 GENERAL**

Central Issue Facility (CIF) is required by the Army to provide a single point for the receipt, storage, issue, exchange and turn-in of all authorized Organizational Clothing and Individual Equipment (OCIE) items at United States Army Installations.

#### **3.2 FUNCTIONAL AND AREA REQUIREMENTS**

Gross building area shall be calculated in accordance with International Building Code. Net area is measured to the inside face of the room or space walls. Minimum dimension where stated shall be measured to the inside face of the defining enclosure. Net area requirements for programmed spaces are included in this paragraph. If net area requirements are not specified, the space shall be sized to accommodate the required function and to comply with code requirements, overall gross area limitations, and any other requirement of this RFP. Area requirements for corridors, stairs, mechanical, electrical and telecommunications rooms will typically be left to the discretion of the Offeror. Specific site requirements that affect the design and construction of the site appear below and in 01 10 00-6.0.

##### **3.2.1 Accessibility Requirements**

CIF facilities shall comply with the ADA Accessibility Guidelines for Buildings and Facilities.

##### **3.2.2 Functional Space Requirements**

###### **3.2.2.1 Permanent Party Wing:**

a. Vestibules: Provide vestibules to serve as transition space between the exterior elements and the facility interior. Minimum depth between exterior and interior doors shall be 7-feet. Vestibules shall open into the queuing/orientation hall.

b. Queuing/Orientation Hall: Provide a queuing/orientation hall, furnished with facility for overhead projection equipment, recessed ceiling mounted projection screen and closed circuit television.

c. CIF Manager: Provide a private office.

d. Property Book Officer: Provide office.

e. Property Section: Provide office.

f. Customer Assistance: Provide a built-in reception desk area furnished with built-in combination work counter and customer service counter. Work counter shall be furnished with a minimum of six lockable lateral file drawer units.

g. Issue/Turn-in Aisle: Provide an issue/turn-in aisle to accommodate issue/turn-in of clothing/equipment at furnished issue/turn-in windows.

h. Fitting Booth: Provide ten fitting booths as shown on the drawing (Appendix J). Each fitting booth shall be sized at a minimum of 42 inches wide x 72 inches deep. Provide a built-in full width bench, two double robe hooks and a full-length mirror (18 inches wide x 66 inches high) in each booth. Provide a seating area furnished with a built-in bench between the two rows of fitting booths. Provide a minimum 16 linear feet of seating surface.

i. Carts: Provide an area for storage of standard commercial type shopping carts.

j. Final Cut Processing: Provide an office with a continuous 24 inches deep built-in counter running along the office side of the wall adjacent to the queing/orientation hall; and a continuous 12 inches deep built-in counter on the queing/orientation hall side of the same wall. Furnish a minimum of three glazed, sliding, lockable, customer service windows along this same wall. Each customer service window shall be 36 inches wide x 36 inches high, glazing shall be minimum ¼-inch laminated glass and each window shall be integrated with a lockable overhead rolling shutter door on the queing/orientation hall side of the window. Counters shall be capable of supporting a minimum of 20 pounds per linear foot.

k. Records Holding: Provide an office with a continuous 24 inches deep built-in counter running along the office side of the wall adjacent to the queing/orientation hall; and a continuous 12 inches deep built-in counter on the queing/orientation hall side of the same wall. Furnish a minimum of three glazed, sliding, lockable, customer service windows along this same wall. Each customer service window shall be 36 inches wide x 36 inches high, glazing shall be minimum ¼-inch laminated glass and each window shall be integrated with a lockable overhead rolling shutter door on the queing/orientation hall side of the window. Counters shall be capable of supporting a minimum of 20 pounds per linear foot.

l. Rollout Storage Bins: Provide designated floor area as shown on the floor plan for roll out storage bins.

m. Corridors: Provide as required. Corridors shall have a minimum width of 72 inches.

n. Male Toilet: Provide toilet facilities to serve the administrative personnel assigned to facility and customers.

o. Female Toilet: Provide toilet facilities to serve the administrative personnel assigned to facility and customers.

p. Janitor's Closet: Provide a janitor's closet. Janitor's closet shall have a 10 inch deep floor mounted stainless steel mop sink, with hot and cold service faucet, a four holder mop rack and two 18 inch deep by 48 inch long heavy duty stainless steel shelves for storage of cleaning supplies. Janitor's closet shall have space for storage of buckets and vacuum.

q. Employee Break Room: Provide a break room with built-in base cabinet with counter top and wall cabinets. Provide a built-in single bowl, stainless steel kitchen sink. Locate a vending area in employee break room. Size vending area to accommodate three full size GFGI vending machines. Provide power receptacles for vending machines.

r. Employee Break Area: Provide a concrete pad exterior break area for employee usage.

#### 3.2.2.2 AIT Wing:

The area designated for AIT operations shall be physically and functionally separated from the Permanent Party Soldiers side with full height, permanent, partitions and doors. The separating partitions and doors shall be designed and installed such that they can be easily deconstructed if necessary with minimal disturbance to adjacent structures finishes and utilities services.

a. Vestibules: Provide vestibules to serve as transition space between the exterior elements and the facility interior. Minimum depth between exterior and interior doors shall be 7-feet. Vestibules shall open into the shake down hall.

b. Shake Down Hall: Provide a shake down hall, furnished with facility for overhead projection equipment, recessed ceiling mounted projection screen and closed circuit television.

c. Customer Assistance: Provide an office with a continuous 24 inches deep built-in counter running along the office side of the wall adjacent to the shake down hall; and a continuous 12 inches deep built-in counter on the shake down hall side of the same wall. Furnish a minimum of two glazed, sliding, lockable, customer service windows along this same wall. Each customer service window shall be 36 inches wide x 36 inches high, glazing shall be minimum ¼-inch laminated glass and each window shall be integrated with a lockable overhead rolling shutter door on the shake down hall side of the window. Counters shall be capable of supporting a minimum of 20 pounds per linear foot.

d. Issue/Turn-in Aisle: Provide an issue/turn-in aisle to accommodate issue/turn-in of clothing/equipment at furnished issue/turn-in windows.

e. Final Processing: Provide an office with a continuous 24 inches deep built-in counter running along the office side of the two walls adjacent to the shake hall; and a continuous 12 inches deep built-in counter on the shake down hall side of the same walls. Furnish a minimum of three glazed, sliding, lockable, customer service windows along the same walls. Each customer service window shall be 36 inches wide x 36 inches high, glazing shall be minimum ¼-inch laminated glass and each window shall be integrated with a lockable overhead rolling shutter door on the shake down hall side of the window. Counters shall be capable of supporting a minimum of 20 pounds per linear foot.

f. Quick Inspection Counter: Provide a 4 feet high screen wall in front of the Issue/Turn-in Aisle. Screen wall shall be furnished with continuous 30 inches deep built-in inspection counter running the entire length of the wall. Counter shall be capable of supporting a minimum of 30 pounds per square foot Set countertop height at 40 inches above finish floor.

g. Rollout Storage Bins: Provide designated floor area as shown on the floor plan for roll out storage bins.

h. Male Toilet: Provide toilet facilities to serve the trainees.

i. Female Toilet: Provide toilet facilities to serve the trainees.

j. Janitor's Closet: Provide a janitor's closet. Janitor's closet shall have a 10 inch deep floor mounted stainless steel mop sink, with hot and cold service faucet, a four holder mop rack and two 18 inch deep by 48 inch long heavy duty stainless steel shelves for storage of cleaning supplies. Janitor's closet shall have space for storage of buckets and vacuum.

### 3.2.2.3 Warehouse Operations Area, Utility Spaces and Optional Spaces:

a. Issue/Turn-in Counter Area: Provide an issue/turn-in counter area to accommodate issue/turn-in of clothing/equipment. Provide a minimum of six issue/turn-in stations each on the Permanent Party side and the AIT side. Each issue/turn-in station shall be minimum 72 inches wide and shall be furnished with a full length 30 inches deep built-in counter capable of supporting a minimum of 30 pounds per square foot. Each issue/turn-in station shall be furnished with an issue/turn-in window minimum 66 inches wide x 36 inches high. Issue/Turn-in window shall be integrated with a lockable overhead rolling shutter door on the issue/turn-in aisle side of the window. Designated floor space shall be provided behind the issue/turn-in counters for flow racks, back-up storage.

b. Secure Storage: Provide a secure storage room for high value items. Secure storage room shall have a minimum of six, 24 inch deep storage shelves, spaced at 15 inches on center vertically and capable of supporting a minimum of 30 pounds per square foot. Total linear footage of storage shelves shall be three times the perimeter of the storage room.

c. Classification Area: Provide a room for classification of issue/turn-in items. Provide continuous 30 inches deep built-in counter running along the three walls of this space as shown. Counters shall be capable of supporting a minimum of 30 pounds per square foot. One wall shall have a cased opening connecting directly to the Repair Area, which shall be located adjacent to the Classification Area. A higher level of illumination is required at the surface of the counter in the Classification Area. See Electrical Section for more information.

d. Repair Area: Provide a room for quick repair of issue items. Provide continuous 30 inches deep built-in counter running along the three walls of this space as shown. Counters shall be capable of supporting a minimum of 30 pounds per square foot. One wall shall have a cased opening connecting directly to the Classification Area, which shall be located adjacent to the Repair Area.

e. Secured Record Storage: Provide records storage rooms adjacent to repair area.

f. Kitting Area: Provide designated floor space as shown for kitting machines. Kitting machines require electrical power connection; see Electrical Section for more information.

g. Warehouse Supervisor: Provide an area in the warehouse adjacent to the loading dock for a warehouse supervisor station. The space shall be 12-feet wide x 10-feet deep and shall be defined by a 4-feet high screen wall. Furnish and install continuous 30-inches deep built-in work counter as shown on the floor plan in Appendix J along each 10 feet wall. Entry into the warehouse supervisor area shall be through a 3-feet wide opening at the center of the 12-foot wall. Counters shall be capable of supporting a minimum of 30 pounds per square foot. Set countertop height at 40-inches above finish floor.

h. Pallet Staging/Special Issue: Provide designated floor space adjacent to the shipping and receiving area as shown for this function.

i. Shipping and Receiving: Provide designated floor space adjacent to the loading dock for this function.

j. Loading Dock: Provide a three bay loading dock. Each bay shall be furnished with a 10 feet wide x 10 feet high overhead door for Receiving/Issuing operations. Door shall be electrically operated with manual over-ride. Provide a reinforced concrete edge guard along the edge of the loading dock as required. Concrete edge guard shall be minimum 1 foot wide and 1 foot high. Mount guardrails on top of concrete edge guard. Loading dock shall be furnished with all necessary dock accessories, including full-pit dock levelers, dock bumpers, fixed and removable safety railing, access stairs, etc. Dock height above the hardstand shall be 48". Truck/trailer heights may vary from 36" above the hardstand up to 60" above the hardstand. Provide high-capacity, low-maintenance, ergonomically-friendly, full-pit dock levelers to accommodate this height range (using electric fork lifts). Dock levelers need to be of sufficient width for safe and efficient fork lift operation and have features intended to prevent lifts from driving off the dock when a truck/trailer is not present.

k. Forklift Access Ramp: Provide a forklift access ramp as one of the loading dock bays. Forklift access ramp shall be designed to provide required turning radius for the forklift described in paragraph 2.1(a). Forklift access ramp shall have a minimum width of 16 feet. Provide a reinforced concrete edge guard along the entire length on both sides of the ramp. Concrete edge guard shall be minimum 1 foot wide and 1 foot high. Mount guardrails on top of concrete edge guard. Access ramp shall be furnished with all necessary dock accessories, including fixed and removable safety railing, access stairs, etc.

l. Heavy Item Stacking: Provide designated floor space adjacent to the shipping and receiving area as shown for this function.

m. Equipment Storage Area: Provide designated floor space adjacent to the heavy item stacking area for storage of forklifts, cherry pickers, pallet jacks, etc. Locate the forklift charge station in this area.

n. Warehouse Area: Provide area for storage of goods on pallets racks. Clear unobstructed height in the entire warehouse area, including the issue/turn-in counter area shall be 25 feet minimum. The Pallet Rack Storage System is a GFGI item. Coordinate with Government to provide suitable space, lighting and structural support for the system and to define detailed requirements. Provide the detailed design layout necessary to purchase and install a complete Pallet Rack System that utilizes industry standard components and dimensions. The rack system shall take full advantage of the 25 foot clear height specified for the warehouse area. System design is to be based on 48" wide X 40" deep X 48" high pallets weighing no more than 2,500 pounds each. Where possible use a standard 9'-3" module (108" open) shelf length. Provide at least two heavy duty (non-waterfall type) pallet supports per pallet space plus wire shelf decking. Provide sufficient rack depth for pallets so that they may be placed flush with the aisle beam face without overhanging on the back side. Install top shelves below the top of 240" standard uprights so that pallets at the end of a row will not accidentally slip off to the side. Pallet rack system design shall include a 4-inch (minimum) clear space between adjacent pallets and a 4-inch (minimum) clear space between the top of each pallet and the bottom of the shelf beam above it. Pallet rack system design shall be such that the top of the load on the top shelves shall be a minimum of 20-inches below clear unobstructed height required in the warehouse. Assume that a fork lift with a 240" mast will be used to place and retrieve pallets.

o. Mechanical, Electrical, and Telecommunications Rooms: Mechanical rooms shall accommodate space for equipment maintenance/repair access without having to remove other equipment. Mechanical, electrical and telecommunications rooms shall be keyed separately for access by Installation maintenance personnel. All telecommunications rooms shall be conditioned space. Telecommunications room will be provided in accordance with the latest I3A guidance. Refer to Mechanical and Electrical Sections for additional information.

p. Mechanical Equipment Yard: Provide a mechanical equipment yard as necessary. Mechanical equipment yard enclosure shall be minimum chain-link wire fencing walls and ceiling.

q. Covered Walkways (BID OPTION): Provide a continuous 10 feet deep covered walkway connecting all entry canopies.



## 3.2.3 Space Allocation Table

| <b>CIF MINIMUM SQUARE FOOTAGE REQUIREMENTS<br/>NET SQUARE FEET (NSF)</b> |  |
|--|--|
| <b>PERMANENT PARTY WING</b>  |  |
| <b>SPACE</b>   | <b>TOTAL NSF</b>                                 |
| VESTIBULES   | AS REQUIRED                                      |
| QUEUING/ORIENTATION HALL   | 13,269   |
| CIF MANAGER  | 192  |
| PROPERTY BOOK OFFICER  | 144  |
| PROPERTY SECTION   | 584  |
| CUSTOMER ASSISTANCE  | 152<br>INCLUDED IN QUEUING/ORIENTATION<br>HALL   |
| ISSUE/TURN-IN AISLE  | INCLUDED IN QUEUING/ORIENTATION<br>HALL          |
| FITTING BOOTHS (10 TOTAL @ 21 NSF EACH)                                  | 210<br>(INCLUDED IN QUEUING/ORIENTATION<br>HALL) |
| FINAL CUT PROCESSING   | 567  |
| RECORDS HOLDING  | 567  |
| ROLL-OUT STORAGE BINS  | 420<br>(INCLUDED IN QUEUING/ORIENTATION<br>HALL) |
| CORRIDOR   | AS REQUIRED                                      |
| MALE TOILET  | 315  |
| FEMALE TOILET  | 220  |
| JANITOR'S CLOSET   | 36   |
| EMPLOYEE BREAK ROOM  | 504  |
| <b>AIT WING</b>  |  |
| VESTIBULES   | AS REQUIRED                                      |
| SHAKE DOWN HALL  | 14,267   |
| CUSTOMER ASSISTANCE  | 192  |
| ISSUE/TURN-IN AISLE  | INCLUDED IN SHAKE DOWN HALL                      |
| FINAL PROCESSING   | 187  |
| QUICK INSPECTION COUNTER   | INCLUDED IN SHAKE DOWN HALL                      |
| ROLL-OUT STORAGE BINS  | 420<br>INCLUDED IN SHAKE DOWN HALL               |
| MALE TOILET  | 315  |
| FEMALE TOILET  | 220  |
| JANITOR'S CLOSET   | 36   |
| ISSUE/TURN-IN COUNTER AREA   | 6,093  |

| <b>CIF MINIMUM SQUARE FOOTAGE REQUIREMENTS<br/>NET SQUARE FEET (NSF)</b> |                                     |
|--|-------------------------------------|
| <b>WAREHOUSE OPERATIONS AREA, UTILITY SPACES AND OPTIONAL SPACES</b>     |                                     |
| SECURE STORAGE   | 806                                 |
| CLASSIFICATION AREA  | 812                                 |
| REPAIR AREA  | 812                                 |
| SECURED RECORD STORAGE   | 135                                 |
| KITTING AREA   | 352<br>INCLUDED IN WAREHOUSE AREA   |
| WAREHOUSE SUPERVISOR   | 120                                 |
| PALLET STAGING/SPECIAL ISSUE   | 3,185<br>INCLUDED IN WAREHOUSE AREA |
| SHIPPING AND RECEIVING   | 3,430<br>INCLUDED IN WAREHOUSE AREA |
| LOADING DOCK   | AS REQUIRED                         |
| FORKLIFT ACCESS RAMP   | AS REQUIRED                         |
| HEAVY ITEM STACKING  | 2,450<br>INCLUDED IN WAREHOUSE AREA |
| EQUIPMENT STORAGE AREA   | 2,646<br>INCLUDED IN WAREHOUSE AREA |
| WAREHOUSE AREA   | 49,512                              |
| EMPLOYEE BREAK AREA  | 600                                 |
| MECHANICAL, ELECTRICAL, TELECOMMUNICATIONS                               | AS REQUIRED                         |
| COVERED WALKWAYS (OPTIONAL)  | AS REQUIRED                         |

### 3.3 SITE REQUIREMENTS

#### 3.3.1 Walks:

Provide pedestrian walks within the designated construction area and connect to existing sidewalks, where applicable. Sidewalks shall be a minimum of 6 feet wide. Pedestrian sidewalks shall be constructed of Portland Cement Concrete having a minimum nominal thickness of 4 inches. Design joint patterns uniformly, symmetrical, and in accordance with American Association of State Highway and Transportation Officials (AASHTO) standards. The length to width ratio shall not exceed 1.25 for non-reinforced pavements.

#### 3.3.2 Site Structures and Amenities

Dumpster Area: Dumpster enclosure area(s) and screening shall be located, designed and constructed by the Contractor. The Contractor is responsible for locating the dumpster areas in accordance with UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings. The GFGI dumpsters shall be located outside of restricted areas to allow for servicing activities. Dumpster pads shall be sized to accommodate both trash and recycling dumpsters. Dumpster screening shall be aesthetically and architecturally compatible with the building it serves and shall be designed in accordance with the Installation's requirements.

### 3.3.3 Site Functional Requirements

(a) External functional requirements include a separate shipping and receiving truck dock with ample concrete hardstand paving for marshalling and parking of supply trucks. See Paragraph 2.1(b) for dock requirements.

(b) Privately Owned Vehicle (POV) Parking: POV parking shall be designed and constructed by the Contractor. The location of the POV parking area(s) shall be designed based on the Installation's site constraints. The Contractor shall ensure that the location of parking complies with UFC 4-010-01. See paragraph 5.2.3 VEHICLE PAVEMENTS for additional requirements. POV parking shall be provided at the rate of one space for each 500 square feet gross office area, plus one space for every four persons assigned to the storage area, or as directed by the Installation. Parking for physically disabled personnel shall be in accordance with the current Americans with Disabilities Act (ADA) guidelines.

(c) Service Drives: The Contractor shall provide service drives to each building. The drives shall be located in accordance with UFC 4-010-01. Where applicable, access to the drives shall be restricted as required by UFC 4-010-01. The pavement design shall be as required by paragraph 5.2.3 VEHICLE PAVEMENTS. The minimum access drive width shall be 10 feet. Provide curb and gutter only where needed for drainage. Minimum turning radius shall be designed as required for emergency vehicle access.

(d) Fire Access Lanes: The Contractor shall provide fire access lanes in accordance with UFC 3-600-01, UFC 4-010-01, NFPA 1 and the Installation's requirements.

## 3.4 ARCHITECTURAL REQUIREMENTS

### 3.4.1 Hardware

3.4.1.1 Non-Destructive Emergency Access System (NDEAS): Furnish and install a Knox-Vault 3200 Series (Single Lock Model) mounted at each building exterior adjacent to the main entry.

3.4.1.2 Finish Hardware: All hardware shall be consistent and shall conform to ANSI/BMHA standards for Grade 1. All requirements for hardware keying shall be coordinated with the Contracting Officer. Hardware finish shall conform to ANSI/BHMA A156 18. Extension of the existing Installation keying system shall be provided. The Installation's keying system is Best Lock. Locksets shall have interchangeable cores. Cores shall have no fewer than seven pins; cylinders shall have key-removable type cores. Disassembly of knob or lockset shall not be required to remove core from lockset. Locksets for mechanical, electrical and telecommunications rooms only shall be keyed to the existing Installation Master Keying System. Deadbolt locks shall be installed on mechanical, electrical and telecommunications rooms keyed to the Installation keying system. All locksets and exit devices shall accept same interchangeable cores. Plastic cores are unacceptable. Provide closers for all exterior doors, all doors opening to corridors and as required by codes. Exit devices shall be installed on all building egress doors.

3.4.1.3. Auxiliary Hardware: Provide wall or floor stops for all exterior doors that do not have overhead holder/stops. Provide other hardware as necessary for a complete installation.

3.4.1.4. Fire Door Hardware: Hardware for fire doors shall be installed in accordance with the requirements of applicable codes. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with applicable codes.

### 3.4.2 Special Acoustical Requirements

3.4.2.1 Exterior walls and roof/floor/ceiling assemblies, doors, windows and interior partitions shall be designed to provide for attenuation of external noise sources such as airfields in accordance with applicable criteria, but no less than the following:

- (a) Interior partitions – STC 42
- (b) Exterior walls – STC 42
- (c) Doors and frames – STC 25

3.4.2.2 Sound conditions and levels for interior spaces, due to the operation of mechanical and electrical systems and devices, shall not exceed levels as recommended by ASHRAE handbook criteria. Provide acoustical treatment for drain lines and other utilities to prevent noise transmission into the offices and other areas requiring noise suppression.

### 3.4.3 Exterior Design Objectives

Provide durable and easily maintainable materials. Do not use exterior materials that require periodic repainting or similar refinishing processes. Material exposed to weather shall be factory pre-finished, integrally colored or provided with intrinsic weathering finish.

3.4.3.1 Exterior Walls: Where Exterior Insulation and Finish Systems (EIFS), or any other material except CMU or other Masonry material is used as exterior finish material, it shall be in conjunction with a CMU wainscot. EIFS shall be “high-impact” type and shall be “drainable” type. Masonry units shall be tested for efflorescence. Efflorescence testing shall conform to the provisions of ASTM C 67. CMU construction shall comply with the provisions of ASTM C 1400.

3.4.3.2 Roof: Minimum roof slope for membrane roof systems shall be 1/4 inch per foot. Minimum roof slope for pitched roof systems shall be as recommended by roof system manufacturer. Membrane roof systems shall be fully adhered. Structural standing seam metal roofs shall comply with the requirements of ASTM E 1592. Roof system shall be Underwriters Laboratory (UL 580 Class 90) rated or Factory Mutual Global (FM) I-90 rated. Roof system shall comply with applicable criteria for fire rating.

(a) Roof Mounted Equipment: For roof-mounted equipment, provide permanent access walkways and platforms to protect roof. Roof mounted equipment on pitched roof systems is unacceptable. Roof mounted equipment on membrane roof systems shall be completely screened by the roof parapet.

(b) Roof access from building exterior is prohibited.

(c) Personal fall arrest systems shall be required for workers servicing roof-mounted equipment. All necessary anchorages for attachment of personal fall arrest equipment shall be provided in accordance with applicable codes and criteria.

3.4.3.3 Trim and Flashing: Gutters, downspouts, and fascias shall be factory pre-finished metal and shall comply with SMACNA Architectural Sheet Metal Manual.

3.4.3.4 Bird Habitat Mitigation: The Contractor shall provide details in the design necessary to eliminate the congregating and nesting of birds at, on, and in the facility.

#### 3.4.3.5 Exterior Doors and Frames:

(a) Main Entrance Doors: Provide aluminum storefront doors and frames with Architectural Class 1 anodized finish, fully glazed, with medium or wide stile for entry into lobbies or corridors. Provide doors complete with frames, framing members, subframes, transoms, sidelights, trim, applied muntins, and accessories. Framing systems shall have thermal-break design. Storefront systems shall comply with wind-load requirements of applicable codes and criteria.

(b) Other Exterior Doors: Provide galvanized insulated hollow metal exterior doors for entry to all spaces other than corridors, lobbies, or reception/waiting rooms. Doors and frames shall comply with applicable codes and criteria. Doors shall be minimum Level 3, physical performance Level A, Model 2 flush; A60 galvanized. Frames shall be 12-gauge, with continuously welded mitered corners and seamless face joints. Doors and frames shall be constructed of hot dipped zinc coated steel sheet, complying with ASTM A653, Commercial Steel, Type B, minimum A40 coating weight; factory primed. Fire-rated openings shall comply with applicable codes, and the requirements of the labeling authority. Door and frame installation shall comply with applicable codes and criteria.

(c) Electrically Operated Sectional Overhead Doors: Doors shall be industrial class, high-lift sectional overhead doors, electrically operated, with auxiliary hand chain override. In the open position, the horizontal portion of the door shall be aligned with the angle of the roof structural elements; and shall be no more than 6 inches below the bottom of the roof structural elements. Doors shall completely close the door opening in the closed position and make the full width and height of the door opening available for use in the open position. Provide a permanent label on the door indicating the name and address of the manufacturer. Door sections shall be formed from hot-dipped galvanized steel, and shall ensure a weather tight closure and alignment for full width and height of the door. Door components and methods of installation shall be designed in accordance with DASMA 102. Minimum design wind load shall be 20 psf. Maximum wind load deflection of the door shall not exceed the door height in inches divided by 120 and the door width in inches divided by 120. Doors shall be operable during design wind load when tested in accordance with ASTM E 330. Provide sections of height per manufacturer's standard. Door sections shall be insulated and shall provide a "U" factor of 0.14 or less when tested in accordance with ASTM C 1363. Interior of door sections shall be covered with steel sheets of not lighter than 20 gage to completely enclose the insulating material. Provide operators of the type recommended by the door manufacturer. Electric operator shall be designed so that the motor may be removed without disturbing the limit switch timing and without affecting the manual operator. The manual operator shall be clutch controlled so that it may be engaged and disengaged from the floor; operation shall not affect limit switch timing. Provide an electrical or mechanical device that disconnects the motor from the operating mechanism when the manual operator is engaged. Provide a galvanized, endless chain operating over a sprocket and extend chain to within 4 feet of the floor and mount on inside of building. The force required to operate the door shall not exceed 35 pounds. Each door motor shall have an enclosed, across-the-line type, magnetic reversing contactor, thermal overload and undervoltage protection, solenoid-operated brake, limit switches, and control switches. Locate control switches at least 5 feet above the floor so the operator will have complete visibility of the door at all times. Control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Control enclosures shall be NEMA ICS 6, Type 12 or Type 4, except that contactor enclosures may be Type 1. Each control switch station shall be of the three-button type; buttons shall be marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons shall require only momentary pressure to operate. The "CLOSE" button shall require constant pressure to maintain the closing motion of the door. If the door is in motion and the "STOP" button is pressed or the "CLOSE" button released, the door shall stop instantly and remain in the stop position; from the stop position, the door may be operated in either direction by the "OPEN" or "CLOSE" buttons. Pushbuttons shall be full-guarded to prevent accidental operation. Provide limit switches to automatically stop doors at the fully open and closed positions. Limit switch positions shall be readily adjustable. Provide a

safety device on the bottom edge of electrically operated doors. The device shall immediately stop and reverse the door in its closing travel upon contact with an obstruction in the door opening or upon failure of the device or any component of the control system and cause the door to return to the full open position. The door-closing circuit shall be automatically locked out and the door shall be operable manually until the failure or damage has been corrected. Do not use the safety device as a limit switch. Each sectional overhead door shall be furnished with a "headache bar" on the interior and exterior side of the facility. Set bottom of each "headache bar" 6-inches below bottom of door head height and 4-feet from face of door. Each sectional overhead door shall be furnished with a canopy on the exterior side. Canopy shall have a minimum depth of 4-feet.

3.4.3.6 Exterior Windows: Provide insulated, high efficiency window systems, with thermally broken frames complying with applicable codes and criteria. Operable windows shall be furnished with locks, and fiberglass or aluminum insect screens removable from the inside. Curtain wall systems shall be capable of withstanding area wind loads, thermal and structural movement required by location and project requirements, and shall comply with applicable codes and criteria. Window sills shall be designed to discourage bird nesting.

3.4.3.7 Exterior Glass and Glazing: Material and installation shall comply with applicable codes and criteria.

3.4.3.8 Thermal Insulation: Provide exterior wall, floor, and roof/ceiling assemblies with thermal transmittance (U-values) required to comply with the proposed energy calculations for the facilities. Insulation shall not be installed directly on top of suspended acoustical panel ceiling systems.

3.4.3.9 Exterior Louvers: Exterior louvers shall have bird screens and shall be designed to exclude wind-driven rain. Exterior louvers shall be made to withstand wind loads in accordance with the applicable codes. Wall louvers shall bear the Air Movement & Control Association (AMCA) International certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. Louver finish shall be factory applied.

#### 3.4.4 Interior Design Objectives

General: Provide sustainable materials and furnishings that are easily maintained and replaced. Maximize use of daylighting. Provide interior surfaces that are easy to clean and light in color. Interior spaces should be structured to allow maximum flexibility for future modifications.

3.4.4.1 Signage: Provide interior signage as required by applicable codes and criteria.

3.4.4.2 Bulletin Boards: Provide one bulletin board at each entry vestibule closest to the customer assistance desk. Bulletin board shall be 4'-0" high and 6'-0" wide. Bulletin boards shall have a header panel and shall have lockable, glazed doors.

3.4.4.3 Corner Guards: Provide surface mounted, high impact resistant, integral color, snap-on type resilient corner guards, extending from floor to ceiling for wall and column outside corners in high traffic areas such as corridors, waiting areas, lobbies, conference and multi-purpose rooms. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards.

3.4.4.4 Chair Rail: Chair rails shall be installed in areas prone to hi-impact use, such as corridors and waiting areas.

3.4.4.5 Casework: Provide cabinets complying with AWI Quality Standards. Countertops shall have waterfall front edge. Countertops at toilets and break room shall also have integral coved backsplash. Public toilet's vanity countertop shall be minimum ½ inch thick cast 100 percent

acrylic polymer solid surfacing material with waterfall front edge and integral coved backsplash.

3.4.4.6 Fire Extinguisher Cabinets and Mounting Brackets: Furnish and install a fire extinguisher cabinet and mounting brackets as required by applicable codes and criteria. Furnish a list of installed fire extinguisher cabinets and mounting brackets (including location, type and size) to the Contracting Officer's Representative.

3.4.4.7 Interior Doors and Frames:

(a) Insulated Hollow Metal Doors: Comply with applicable codes and criteria. Doors shall be minimum Level 3, Physical Performance Level A, Model 2; factory primed. Provide insulated hollow metal doors at all interior door locations. Provide solid core insulated hollow metal doors with a wood grain finish at all offices.

(b) Hollow Metal Frames: Comply with ANSI A250.8/SDI 100. Frames shall be minimum Level 3, 16 gauge, with continuously welded mitered corners and seamless face joints; factory primed. All door frames shall be hollow metal frames.

(c) Fire-rated and Smoke Control Doors and Frames: Comply with applicable codes, criteria and requirements of labeling authority.

(d) STC ratings shall be of the sound classification required and shall include the entire door and frame assembly.

3.4.4.8 Window Treatment: Provide horizontal mini blinds at all exterior windows. Uniformity of window covering color and material shall be maintained to the maximum extent possible throughout each building. Window stools shall be minimum ½ inch thick cast 100 percent acrylic polymer solid surfacing material. Uniformity of window covering color and material shall be maintained throughout the building.

3.4.4.9 Mold Mitigation: The Designer of Record shall provide details in the design analysis and design showing steps taken to mitigate the potential growth of mold and mildew in the facility.

3.4.4.10 Toilet Accessories: Furnish and install the items listed below and all other toilet accessories necessary for a complete and usable facility. All toilet accessories shall be Type 304 stainless steel with satin finish. Toilet accessories shall include the following:

(a) Glass Mirror/Shelf – 18 inch by 24 inch glass mirror on stainless steel frame with shelf at each lavatory

(b) Hands free liquid soap dispenser at each lavatory

(c) Hands free paper towel dispenser

(d) Waste receptacle- recess mounted at each lavatory/toilet area

(e) Sanitary napkin disposal at each female toilet stall

(f) Toilet paper dispenser – lockable multiple roll toilet paper dispenser at each toilet stall

(g) Sanitary toilet seat cover dispenser – at each toilet stall

(h) Grab bars – as required by ADA

### 3.4.5 Finishes

Designers are not limited to the minimum finishes listed in this paragraph and are encouraged to offer higher quality finishes.

#### 3.4.5.1 Minimum Paint Finish Requirements

(a) All paints used shall be listed on the "Approved Product List" of the Master Painters Institute (MPI). Application criteria shall be as recommended by MPI guide specifications for the substrate to be painted and the environmental conditions existing at the project site.

(b) Exterior surfaces, except factory pre-finished material or exterior surfaces receiving other finishes shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Exterior paints and coating products shall be classified as containing low volatile organic compounds (VOCs) in accordance with MPI criteria. Application criteria shall be as recommended by MPI guide specifications. Provide an MPI Gloss Level 5 Finish (semi-gloss), unless otherwise specified.

(c) Interior surfaces, except factory pre-finished material or interior surfaces receiving other finishes, shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Interior paints and coating products shall contain a maximum level of 150 grams per liter (g/l) of VOCs for non-flat coatings and 50 g/l of VOCs for flat coatings. Provide an MPI Gloss Level 5 Finish (semi-gloss) in wet areas and a flat finish in all other areas.

#### 3.4.5.2 Minimum Interior Finish Requirements

(a) Wall, ceiling and floor finishes and movable partitions shall conform to the requirements of the IBC, NFPA and UFC 3-600-01 Fire Protection Engineering for Facilities. Where code requirements conflict, the most stringent code requirement shall apply.

(b) Carpet shall be minimum of 2 yarn ply, modular tile conforming to ISO 2551, ASTM D 418, ASTM D 5793, ASTM D 5848, solution dyed, tufted, cut and loop pile, commercial 100% branded (federally registered trademark) nylon continuous filament. Vinyl composition tile (VCT) shall be minimum 1/8 inch thick, conforming to ASTM F 1066, Class 2, through pattern tile, Composition 1, asbestos free, with color and pattern uniformly distributed throughout the thickness of the tile.

(c) Walls: All wall finish shall be minimum 5/8" painted gypsum board, except where stated otherwise. Gypsum board shall be paperless gypsum board. Use impact resistant paperless gypsum board in corridors and storage rooms. Gypsum wall board shall not be used as a wall finish in the warehouse area below 8 feet above finish floor. The warehouse side of all gypsum wall board partitions shall have a minimum 20 gage sheet metal finish up to a height of 8 feet above the finish floor.

(d) All ceiling finishes shall be minimum 5/8" painted gypsum board, except where stated otherwise. Gypsum board shall be paperless gypsum board.



## 3.4.5.3 Interior Finishes Table

| CIF INTERIOR FINISHES   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
|---|--------------------|--------------------------|--------------|--------------------|-----------------|----------------|--------------------------|--------------|-------------------------|---|--------------|--|-------------------------|-------------------------|-------------------|--|----------------|
|   | FLOORS             |                          |              |                    |                 | BASE           |                          |              | WALLS                   |   |              |  | CEILING                 |                         |                   |  | REMARKS        |
|   | RESILIENT FLOORING | PORCELAIN OR QUARRY TILE | CERAMIC TILE | RECESSED ENTRY MAT | SEALED CONCRETE | RESILIENT BASE | PORCELAIN OR QUARRY BASE | CERAMIC BASE | GYPSUM WALL BOARD-PAINT | FULLY GROUTED REINF. CMU OR REINF. CONCRETE | CERAMIC TILE | LAMINATED GLASS, INSUL. STORE FRONT SYSTEM | GYPSUM WALL BOARD PAINT | ACOUSTICAL CEILING TILE | PAINTED STRUCTURE | MINIMUM HEIGHT 9'-0" UNLESS STATED OTHERWISE | REFER TO NOTE. |
| PERMANENT PARTY WING  |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| VESTIBULES  |                    | •                        |              | •                  |                 |                | •                        |              | •                       |   |              | •  |                         | •                       |                   | 10'  |                |
| QUEUING/ ORIENTATION HALL                                     |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| CIF MANAGER   | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  |                |
| PROPERTY BOOK OFFICER   | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  |                |
| PROPERTY SECTION  | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  |                |
| CUSTOMER ASSISTANCE   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| ISSUE/TURN-IN AISLE   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| FITTING BOOTHS  |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  | •                       |                         |                   |  |                |
| FINAL CUT PROCESSING  | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| RECORDS HOLDING   | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| ROLL-OUT STORAGE BINS   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| MALE TOILET   |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 1         |
| FEMALE TOILET   |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 1         |
| JANITOR'S CLOSET  |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 2         |
| EMPLOYEE BREAK ROOM   | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| AIT WING  |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| VESTIBULES  |                    | •                        |              | •                  |                 |                | •                        |              | •                       |   |              | •  |                         | •                       |                   | 10'  |                |
| SHAKE DOWN HALL   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| CUSTOMER ASSISTANCE   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| ISSUE/TURN-IN AISLE   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| FINAL PROCESSING  | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  |                         | •                       |                   |  | NOTE 3         |
| ROLL-OUT STORAGE BINS   |                    | •                        |              |                    |                 |                | •                        |              | •                       |   |              |  |                         | •                       |                   | 12'  |                |
| MALE TOILET   |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 1         |
| FEMALE TOILET   |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 1         |
| JANITOR'S CLOSET  |                    |                          | •            |                    |                 |                |                          | •            | •                       |   | •            |  | •                       |                         |                   |  | NOTE 2         |
| WAREHOUSE OPERATIONS AREA, UTILITY SPACES AND OPTIONAL SPACES |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| ISSUE/TURN-IN COUNTER AREA                                    |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTES 6, 7, 8  |
| SECURE STORAGE  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  | •                       |                         |                   | 10'  | NOTE 7, 8      |
| CLASSIFICATION AREA   |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  | •                       |                         |                   | 10'  | NOTE 7 & 8     |
| REPAIR AREA   |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  | •                       |                         |                   | 10'  | NOTE 7 & 8     |
| SECURED RECORD STORAGE  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  | •                       |                         |                   | 10'  | NOTE 7 & 8     |
| KITTING AREA  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6, 7, 8   |
| WAREHOUSE SUPERVISOR  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         |                   | 25'  | NOTE 6, 7, 8   |

| CIF INTERIOR FINISHES   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
|---|--------------------|--------------------------|--------------|--------------------|-----------------|----------------|--------------------------|--------------|-------------------------|---|--------------|--|-------------------------|-------------------------|-------------------|--|----------------|
|   | FLOORS             |                          |              |                    | BASE            |                |                          | WALLS        |                         |   |              | CEILING                                    |                         |                         |                   | REMARKS                                      |                |
|   | RESILIENT FLOORING | PORCELAIN OR QUARRY TILE | CERAMIC TILE | RECESSED ENTRY MAT | SEALED CONCRETE | RESILIENT BASE | PORCELAIN OR QUARRY BASE | CERAMIC BASE | GYPSUM WALL BOARD-PAINT | FULLY GROUTED REINF. CMU OR REINF. CONCRETE | CERAMIC TILE | LAMINATED GLASS, INSUL. STORE FRONT SYSTEM | GYPSUM WALL BOARD PAINT | ACOUSTICAL CEILING TILE | PAINTED STRUCTURE | MINIMUM HEIGHT 9'-0" UNLESS STATED OTHERWISE | REFER TO NOTE. |
| WAREHOUSE OPERATIONS AREA, UTILITY SPACES AND OPTIONAL SPACES   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| PALLET STAGING/SPECIAL ISSUE  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6, 7, 8   |
| SHIPPING AND RECEIVING  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6,7,8     |
| LOADING DOCK  |                    |                          |              |                    | •               |                |                          |              |                         |   |              |  |                         |                         |                   |  | NOTE 5         |
| FORKLIFT ACCESS RAMP  |                    |                          |              |                    | •               |                |                          |              |                         |   |              |  |                         |                         |                   |  | NOTE 5         |
| HEAVY ITEM STACKING   |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6,7,8     |
| EQUIPMENT STORAGE AREA  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6,7,8     |
| WAREHOUSE AREA  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  |                         |                         | •                 | 25'  | NOTE 6,7,8     |
| MECHANICAL, ELECTRICAL  |                    |                          |              |                    | •               | •              |                          |              | •                       |   |              |  | •                       |                         | •                 |  | NOTE 6         |
| TELECOMMUNICATIONS  | •                  |                          |              |                    |                 | •              |                          |              | •                       |   |              |  | •                       |                         |                   |  |                |
| EMPLOYEE BREAK AREA   |                    |                          |              |                    | •               |                |                          |              |                         |   |              |  |                         |                         |                   |  | NOTE 5         |
| COVERED WALKWAYS (OPTIONAL)   |                    |                          |              |                    | •               |                |                          |              |                         |   |              |  |                         |                         |                   |  | NOTE 4, 5      |
| 1. ALL WET WALLS IN TOILET ROOMS SHALL HAVE 4'-0" HIGH CERAMIC TILE WAINSCOT. ALL SHOWERS SHALL HAVE FULL HEIGHT TILE WALLS. VANITY TOPS SHALL BE CAST 100 PERCENT ACRYLIC POLYMER SOLID SURFACING MATERIAL WITH WATERFALL FRONT EDGE AND A MINIMUM 4" INTEGRAL COVED BACKSPLASH. |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 2. WALLS ADJACENT TO JANITOR'S SINK SHALL HAVE A 4'-0" HIGH CERAMIC TILE WAINSCOT.  |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 3. ALL COUNTER TOPS SHALL HAVE A WATERFALL FRONT EDGE. COUNTER TOP IN BREAK ROOM SHALL HAVE A MINIMUM 4" INTEGRAL COVED BACKSPLASH.   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 4. CEILING IS PAINTED CANOPY STRUCTURE AT COVERED WALKWAYS.   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 5. WALL AND BASE ARE BUILDING EXTERIOR FINISH.  |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 6. CEILING SHALL BE PAINTED STRUCTURE IF ALLOWED BY APPLICABLE CODE   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 7. THE AREA FROM THE ISSUE/TURN-IN COUNTER BACK TO THE BACK-END OF THE WAREHOUSE AREA SHALL BE CLEAR OF STRUCTURAL OBSTRUCTION TO A HEIGHT OF 25'-0" ABOVE FINISH FLOOR.  |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |
| 8. THE WAREHOUSE SIDE OF ALL GYPSUM WALL BOARD PARTITIONS/FINISHES SHALL HAVE A MINIMUM 20 GAGE SHEET METAL FINISH UP TO A HEIGHT OF 8 FEET ABOVE THE FINISH FLOOR.   |                    |                          |              |                    |                 |                |                          |              |                         |   |              |  |                         |                         |                   |  |                |

## 3.4.5.4 CIF Furniture Chart

| Description                                   | Comments                        | Furniture Required   |
|---|---------------------------------|--|
| Queuing/Orientation Hall                      | Reception/Waiting               | 168 wait seating, ganged in groups of eight.   |
| CIF Manager                                   | Private Office                  | L-shaped double pedestal modular desk, hutch, one 4-drawer lateral file, one bookcase, one guest chair, one managerial chair |
| Property Book Officer                         | Private Office                  | L-shaped double pedestal modular desk, hutch, one 4- drawer lateral files, one managerial chair, one guest chair             |
| Property Section                              | 48 NSF Open Workstations        | Four modular workstations with work surfaces, file pedestals, and overhead storage, four task chairs                         |
| Customer Assistance<br>(Permanent Party Area) | Reception                       | Built-in combination work counter and customer service counter. Work counter furnished with lockable lateral file drawers    |
| Final Cut Processing                          | Reception                       |  |
| Records Holding                               | 48 NSF Open Workstations/Filing | L-shaped double pedestal desk, 20 4-drawer vertical files, two counter-height stools, one task chair, two guest chairs       |
| Employee Break Room                           | Break area                      | One rectangle table with seating for 10  |
| Customer Assistance<br>(AIT Area)             | Reception                       |  |
| Final Processing                              |                                 |  |
| Quick Inspection Counter                      | Issue Line                      | Built-in counter   |
| Issue/Turn-in Counter Area                    | Issue Line                      |  |
| Secure Storage                                | Storage                         | Built-in shelving  |
| Classification Area                           | 48 NSF Open Workstations/Filing | Two modular workstations with work surfaces, file pedestals, and overhead storage, four task chairs                          |
| Repair Area                                   | 48 NSF Open Workstations/Filing | Six modular workstations with work surfaces, file pedestals, and overhead storage, four task chairs                          |
| Warehouse Supervisor                          | 48 NSF Open Workstations        | L-shaped double pedestal modular desk, hutch, three 4-drawer vertical files, one task chair                                  |

3.5      STRUCTURAL REQUIREMENTS

Design and construct as a complete system in accordance with APPLICABLE CRITERIA.

Live Loads: Design live loads shall be per the IBC but not lower than the following minimums.

- (a) Primary roof members, exposed to work floor (in addition to the uniform load):  
Single panel point on lower chord of roof trusses or any point along primary structural members supporting roofs.....2,000 pounds
- (b) Floor slab:
  - (1) Warehouse: The most stringent loading of the following:
    - (a) Uniform load..... 250 psf
    - (b) Fork lift, with lifting capacity of ..... 5000 lb
    - (c) 4'X3' X 40" deep pallets with average weight of 1500 lb each will be stacked 5 high in storage racks. (Maximum pallet weight is 2500 lb). Slab shall be designed for all loads induced on slab by racking system.
  - (2) Administration ..... 250 psf
- (c) Mezzanine.....150 psf

Frame spacing shall not be less than 25 feet in the long direction of the warehouse. Refer to Section 01 10 00 Paragraph 2.1.e for more information. Columns are to be spaced in such a way as to allow standard industrial shelving for palletized loading. Shelving shall be constructed in a back-to-back double row configuration with no interspersed single rows.

3.6      MECHANICAL REQUIREMENTS

3.6.1 Plumbing

3.6.1.1 Plumbing system shall be designed and installed in accordance with the International Plumbing Code (IPC). Fixtures shall be of the water saving type and approved for its use per the IPC. Hot water shall be provided for all lavatories. Refer to paragraph 5 for domestic water metering requirements.

3.6.1.2 Gas systems (if applicable) shall be designed and installed in accordance with NFPA 54. Gas fired appliances shall be of the energy saving type. Refer to paragraph 5 for gas metering requirements.

3.6.1.3 Locate emergency eye wash stations in accordance with OSHA standards 1910 and 1926. Water must be heated and a thermostatic tempering valve employed to provide water at the OSHA-required temperature. Provide a floor drain with a secondary waterless trap.

3.6.1.4 Provide floor drains in toilets to facilitate proper maintenance.

3.6.1.5 Wall Hydrants: Provide a minimum of 4 exterior wall hydrants, at least one per face of the building. Hydrants shall have a removable key and freeze protection. Wall hydrants shall be mounted 2 feet above finished grade and will be spaced around the building perimeter to allow maintenance with no greater than 100 feet of garden hose.

3.6.2 Heating, Ventilating and Air Conditioning (HVAC)

3.6.2.1 The permanent party area, AIT area, issue/turn in area (back-up storage), secure storage

area, classification area, and repair area shall be heated and air conditioned. Air conditioned space shall have user adjustable controls of +/- 2 degrees F with a set point of 75 degrees F for cooling and 70 degrees F for heating. Installation shall be in accordance with the International Mechanical Code (IMC). Toilets shall be continuously exhausted during occupied hours. Air conditioning for communications room shall remain active at all times.

3.6.2.2 Open warehouse areas shall be heated and ventilated separately from air-conditioned space and maintained at a minimum of 55 degrees F during occupied hours. During non occupied hours the temperature shall be maintained at a minimum of 40 degrees F for freeze protection. Air conditioning is not allowed in open warehouse areas. Installation shall be in accordance with the IMC. Freeze protection is required in the fire riser room and mechanical room. Electrical and mechanical rooms should be ventilated.

3.6.2.3 Refer to Paragraph 5 for temperature control information.

3.6.2.4 Split system air handling units (if used) shall be located in a mechanical room accessible only through an exterior door. Mechanical rooms shall be sized for ease of service, maintenance, and replacement of HVAC equipment. Design shall be such that equipment is not "trapped" in the space. Rooftop-mounted equipment shall be accessible by means of a fully caged roof ladder accessible only from the interior of the building. Provide a lockable, full size roof hatch for the ladder.

3.6.2.5 Air conditioned space zoning shall be based on exterior envelope exposures. Where VAV systems are used, limit individual zones to a maximum of 2,500 cfm.

3.6.2.6 Air handling units shall run continuously during occupied hours. Similarly, outdoor ventilation air required by ASHRAE 62.1 shall be continuous during occupied hours.

3.6.2.7 Equipment located outside (on the ground) shall be enclosed in a security-screened equipment yard. Sound/noise shall be a consideration in the selection of all equipment.

3.6.2.8 For hot weather provide a manually-controlled, up-blast, fan-powered (curb-mounted), warehouse ventilation system capable of exhausting stratified hot, stale air trapped below the roofline at a minimum rate of 4 cfm per square foot of under-roof-area open to the warehouse. Cfm rating shall be at no less than 0.125 inch of static pressure. Limit noise level (per exhaust ventilator) to 50 fan sones (measured at 5 feet per AMCA Standard 301, installation A, tested at zero static pressure). Fixed exhaust volume (per ventilator fan) shall fall between 23,000 cfm minimum and 45,000 cfm maximum at 0.125 inch of static pressure. Ventilators shall have a cfm to sone ratio of at least 800 (cfm/sones = 800+). Ventilator ratings, etc. shall come from regularly published data provided by the equipment manufacturer. Locate ventilators to maximize the sweep of fresh air through the warehouse and prevent short-circuiting of air between intake and exhaust points. To minimize condensation, ventilator butterfly dampers shall be made from non-metallic material such as epoxy-fiberglass and have molded-in one-piece axles. Provide drip pans to catch any condensate. Provide separate on/off control for each ventilator at a convenient single location. For purposes of night cool down provide low-wall, rain-resistant, air intake, wall louvers with motorized dampers and insect screens. Size louvers for 3 air changes per hour (based on open warehouse under-roof volume only) to produce a net free area velocity of no more than 500 fpm. If excess airflow is necessary (because of fan sizing) to meet the minimum airflow requirement then louvers must be sized so as to not exceed the 500 fpm maximum. Locate the louvers so as to promote balanced airflow and prevent short circuiting. Interlock fans/dampers so that operation of a single fan or any combination of fans will open all of the dampers. With all fans operating (and all dock doors and dampers open) the velocity through the free area of all louvers and dock doors shall not exceed 500 fpm. To prevent back-drafting of gas-fired appliances interlock ventilators to heating units so that they will not fire if ventilators are energized. Heating unit interlocks are not required for appliances whose combustion air supply

does not communicate with the warehouse space.

3.6.2.9 Per 29 CFR 1910 and other applicable criteria provide for sufficient diffusion and ventilation of gases from fork lift storage batteries to prevent the accumulation of explosive mixtures. Batteries will be charged "in place". Provide a charging area or room (with a properly designed ventilation system) for two (2) forklifts/chargers. Forklifts and charging equipment (GFGI) are not included in this project.

3.6.2.10 Air conditioned space must comply with the thermal comfort criteria required by LEED EQ 7.1. However, only if the entire building complies with EQ 7.1 will the credit be earned. The mandatory requirement of Paragraph 5 that EQ 7.1 be earned for LEED Silver does not apply to this facility.

### 3.7 ELECTRICAL AND TELECOMMUNICATIONS REQUIREMENTS

Select electrical characteristics of the power system to provide a safe, efficient, and economical distribution of power based upon the size and types of loads to be served. Use distribution and utilization voltages of the highest level that is practical for the load to be served. The effect of nonlinear loads such as computers, other electronic equipment and electronic ballasts shall be considered and accommodated as necessary. Voltage drop shall not exceed the maximum allowed per ASHRAE 90.1. Transient voltage surge protection shall be provided on service equipment.

#### 3.7.1 Power outlet

Power shall be provided for all installed equipment requiring power including all government furnished contractor installed equipment and all GFGI equipment. Power poles are not allowed. The following shall also be provided.

3.7.1.1 Provide 125-volt duplex receptacles per NFPA 70, in conjunction with the proposed equipment and furniture layouts, and as per other stated requirements elsewhere in the RFP.

3.7.1.2 In addition to receptacles required elsewhere in the RFP provide one 125-volt duplex receptacle per wall in all normally occupied spaces.

3.7.1.3 For housekeeping purposes provide a minimum of one 125-volt duplex receptacle per corridor. No point along the corridor shall be more than 25 feet from a receptacle.

3.7.1.4 Provide 125-volt duplex receptacles mounted adjacent to lavatories. Provide a minimum of one for every two adjacent lavatories. Each single lavatory shall also be provided a receptacle.

3.7.1.5 Provide a minimum of two 125-volt duplex receptacles in each mechanical room in addition to NFPA 70 requirements. In addition, provide a minimum of one 125-volt duplex receptacle in each electrical room.

3.7.1.6 Provide 125-volt duplex receptacles within the warehouse area. No point along perimeter walls in the warehouse shall be more than 25 feet from a receptacle. If applicable, install receptacles on columns.

3.7.1.7 Provide a 125-volt duplex receptacle on the exterior wall near each entrance door of the building. Receptacles shall be provided with ground fault protection and suitable for a wet location.

3.7.1.8 Provide a minimum of two 125-volt duplex receptacles with dedicated circuits in the forklift area for forklift battery chargers.

3.7.1.9 Provide 125-volt duplex receptacles within Shake Down Hall and Queuing/Orientation Hall. No point along perimeter walls in the Shake Down Hall and Queuing/Orientation Hall shall be more than 25 feet from a receptacle.

3.7.1.10 Provide a 220-volt, 3-phase, 20-amp receptacle with dedicated circuit for each Kitting machine within Kitting Area. Kitting machines will be GFGL.

### 3.7.2 Grounding

Grounding shall be provided in accordance with NFPA 70 and the UFC 3-580-01 Telecommunications Bldg Cabling Systems Planning/Design.

### 3.7.3 Lighting

Interior lighting controls shall be provided in accordance with ASHRAE 90.1. Compact fluorescent lamps of 12 watts or less shall not be used. Provided lighting levels shall be within +/- 10% of required lighting levels.

3.7.3.1 Warehouse storage area shall be illuminated with T8 fluorescent lighting fixtures to a level of 20 foot-candles. The lighting fixtures shall be mounted so that the bottom of the fixture will be above the bottom of the roof frame.

3.7.3.2. Issue/Turn-In stations shall be illuminated to a level of 30 foot-candles. In addition, each Issue/Turn-in station shall be provided with down light that shall have the ability to illuminate to a level of 50 foot-candles.

3.7.3.3 Repair room, and classification room shall be illuminated to a level of 50 foot-candles.

3.7.3.4 Provide 30 foot-candles lighting level in areas that are not covered by IESNA or indicated herein.

### 3.7.4 Telecommunications

Telecommunication outlets shall be provided per the applicable criteria based on functional purpose of the space within the building and in accordance with other provisions of this RFP.

3.7.4.1 Provide voice and data connection capability to all workstations.

3.7.4.2 Provide a voice and data connection capability to each Issue/Turn-in stations

3.7.4.3 Equipment Racks shall be standard self standing 84 inches height and 19 inches wide.

3.7.4.4 Service riser conduits in main telecommunications room shall be located behind the equipment racks.

3.7.4.5 Provide voice and data connection capability at projector locations.

### 3.7.5 Cable TV (CATV)

All CATV outlet boxes, connectors, cabling, and cabinets shall conform to UFC-3-580-01 Telecommunication Bldg Cabling System Planning/Design, unless noted otherwise. All horizontal cabling shall be homerun from the CATV outlet to the nearest telecommunications room. CATV connectivity shall be provided in: Shake Down Hall, Queuing/Orientation Hall and Employee

Break room areas. See paragraph 6 for additional requirements.

#### 3.7.6 Paging System

A zoned paging system shall be provided throughout the facility and integrated with the telephone system. System may utilize mass notification amplifiers and speakers, but shall be overridden by the mass notification system if mass notification system is activated while the paging system is being utilized. System shall have a minimum capacity of eight zones. Facility shall be zoned per user requirements.

#### 3.7.7 Intrusion Detection System (IDS)

IDS shall be included empty conduits and junction boxes at the control panels, balanced magnetic switches, and motion sensors unless specified otherwise in paragraph 6.10 FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS. Control panel and balanced magnetic switch locations shall include all exterior doors. Motion sensor locations shall include in the Warehouse, Permanent Party Area, and AIT Area. Empty conduit with pull string shall be installed to communication room. Design Build Contractor shall coordinate with the Installation Physical Security Officer during design for the locations and connection points of IDS devices. The IDS control panels, balanced magnetic switches, and motion sensors will be GFGI.

### 3.8 FIRE ALARM REQUIREMENTS

3.8.1 There shall be one complete supervised addressable fire alarm system for the building. This system shall consist of a fire alarm panel, a communication device, initiating devices and notification devices.

3.8.2. All software, software locks, special tools and any other proprietary equipment required to maintain, add devices to or delete devices from the system, or test the fire alarm system shall become property of the Government and be furnished to the Contracting Officer's Representative prior to final inspection of the system.

3.8.3. The fire alarm system shall be designed by a registered Fire Protection Engineer and installation shall be supervised by a National Institute for Certification of Engineering Technologies (NICET) level-3 (minimum) technician. Fire alarm system shall be designed and installed in accordance with NFPA 72.

### 3.9 MASS NOTIFICATION SYSTEM (MNS)

MNS shall be integrated into the installation's area wide MNS (Giant Voice). See paragraph 6 for further requirements.

### 3.10 FIRE PROTECTION

3.10.1 Fire suppression systems shall be designed in accordance with the latest edition of UFC 3-600-01. Warehouse and storage areas shall be protected utilizing Early Suppression Fast Response (ESFR) type sprinklers. ESFR shall be designed and installed in accordance with NFPA 13. ESFR system shall be on a separate fire riser from the rest of the building. (Note 1: maximum roof slope for ESFR is 2/12. Note 2: pallet storage may be stacked within 20" of the 25' clear height specified.)

3.10.2 Fire pumps, if required, shall be installed in accordance with NFPA 20. Fire pumps shall be installed in a separate room with access from the exterior. Fire pump room shall have one hour separation from the rest of the building.

3.10.3 Water storage tanks, if required, shall meet the requirements of UFC 3-600-01 and NFPA



22. Water tanks must be supervised by the building's fire alarm system.

3.10.4 Fire Department Connection (FDC) shall be provided in accordance with NFPA requirements.

3.10.5 Post Indicator Valve (PIV) shall be provided in accordance with NFPA requirements. PIV shall be supervised by the building fire alarm system.

#### 4.0 APPLICABLE CRITERIA

Unless a specific document version or date is indicated, use criteria from the most current references, including any applicable addenda, unless otherwise stated in the contract or task order, as of the date of the Contractor's latest accepted proposal or date of issue of the contract or task order solicitation, whichever is later. In the event of conflict between References and/or Applicable Military Criteria, apply the most stringent requirement, unless otherwise specifically noted in the contract or task order.

##### 4.1. INDUSTRY CRITERIA

Applicable design and construction criteria references are listed in Table 1 below. This list is not intended to include all criteria that may apply or to restrict design and construction to only those references listed. See also Paragraph 3 for additional facility-specific applicable criteria.

**Table 1: Industry Criteria**

| <b>Air Conditioning and Refrigeration Institute (ARI)</b>                          |  |
|--|--|
| ARI 310/380  | Packaged Terminal Air-Conditioners and Heat Pumps  |
| ARI 440  | Room Fan-Coil and Unit Ventilator  |
| ANSI/ARI 430-99  | Central Station Air Handling Units   |
| ARI 445  | Room Air-Induction Units   |
| ARI 880  | Air Terminals  |
| <b>Air Movement and Control Association (AMCA)</b>                                 |  |
| AMCA 210   | Laboratory Methods of Testing Fans for Rating  |
| <b>American Architectural Manufacturers Association (AAMA)</b>                     |  |
| AAMA 605   | Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels |
| AAMA 607.1   | Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum                                   |
| AAMA 1503  | Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections                      |
| <b>American Association of State Highway and Transportation Officials (AASHTO)</b> |  |
|  | Roadside Design Guide [guardrails, roadside safety devices]  |

|   |  |
|---|--|
|   | Standard Specifications for Transportation Materials and Methods of Sampling and Testing [Road Construction Materials] |
|   | Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals                      |
|   | Guide for Design of Pavement Structures, Volumes 1 and 2 [pavement design guide]                                       |
|   | A Policy of Geometric Design of Highways and Streets   |
| <b>American Bearing Manufacturers Association (AFBMA)</b> |  |
| AFBMA Std. 9  | Load Ratings and Fatigue Life for Ball Bearings  |
| AFBMA Std. 11   | Load Ratings and Fatigue Life for Roller Bearings  |
| <b>American Boiler Manufacturers Association (ABMA)</b>   |  |
| ABMA ISEI   | Industry Standards and Engineering Information   |
| <b>American Concrete Institute</b>                        |  |
| ACI 302.2R  | Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials  |
| ACI 318   | Building Code Requirements for Structural Concrete   |
| ACI SP-66   | ACI Detailing Manual   |
| ACI 530   | Building Code Requirements for Masonry Structures  |
| <b>ADA Standards for Accessible Design</b>                |  |
| See US Access Board                                       | ADA and ABA Accessibility Guidelines for Buildings and Facilities, Chapters 3-10.                                      |
| <b>American Institute of Steel Construction (AISC)</b>    |  |
|   | Manual of Steel Construction – 13 <sup>th</sup> Edition (or latest version)  |
| <b>American Iron and Steel Institute</b>                  |  |
| AISI S100   | North American Specification for the Design of Cold-Formed Steel Structural Members                                    |

| <b>American National Standards Institute 11 (ANSI)</b>                                    |  |
|---|--|
| ANSI Z21.10.1   | Gas Water Heaters Vol. 1, Storage water Heaters with Input Ratings of 75,000 Btu per Hour or less  |
| ANSI Z124.3   | American National Standard for Plastic Lavatories  |
| ANSI Z124.6   | Plastic Sinks  |
| ANSI Z21.45   | Flexible Connectors of Other Than All-Metal Construction for Gas Appliances  |
| ANSI/IEEE C2-2007   | National Electrical Safety Code  |
| ANSI/AF&PA NDS-2001   | National Design Specification for Wood Construction  |
| <b>American Society of Civil Engineers (ASCE)</b>   |  |
| ASCE 7  | Minimum Design Loads for Buildings and Other Structures  |
| ASCE 37   | Design and Construction of Sanitary and Storm Sewers, Manuals and Reports on Engineering Practice [sanitary sewer and storm drain design criteria] |
| ASCE/SEI 31-03  | Seismic Evaluation of Existing Buildings [Existing Building Alteration/Renovation]   |
| ASCE/SEI 41-06  | Seismic Rehabilitation of Existing Buildings [Existing Building Alteration/Renovation]   |
| <b>American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)</b> |  |
| ASHRAE 90.1   | ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings  |
| ASHRAE Guideline 0  | The Commissioning Process  |
| ASHRAE Guideline 1.1  | The HVAC Commissioning Process   |
| ASHRAE Handbooks  | Fundamentals, HVAC Applications, Systems and Equipment, Refrigeration (Applicable, except as otherwise specified)                                  |
| ASHRAE Standard 15  | Safety Standard for Refrigeration Systems  |
| ASHRAE Standard 62.1  | Ventilation for Acceptable Indoor Air Quality  |

|  |  |
|--|--|
| ASHRAE Standard 55   | Thermal Environmental Conditions for Human Occupancy (Design portion is applicable, except where precluded by other project requirements.) |
| <b>American Society of Mechanical Engineers International (ASME)</b> |  |
| ASME BPVC SEC VII  | Boiler and Pressure Vessel Code: Section VII Recommended Guidelines for the Care of Power Boilers  |
| ASME A17.1   | Safety Code for Elevators and Escalators   |
| ASME B 31 (Series)   | Piping Codes   |
| <b>American Water Works Association (AWWA)</b>                       |  |
|  | Standards [standards for water line materials and construction]  |
| <b>American Welding Society</b>                                      |  |
|  | Welding Handbook   |
|  | Welding Codes and Specifications (as applicable to application, see International Building Code for example)                               |
| <b>Architectural Woodwork Institute (AWI)</b>                        |  |
| Latest Version   | AWI Quality Standards  |
| <b>Associated Air Balance Council (AABC)</b>                         |  |
| AABC MN-1  | National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems  |
|  | AABC Associated Air Balance Council Testing and Balance Procedures   |
| <b>ASTM International</b>  |  |
| ASTM C1060-90(1997)  | Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings                         |
| ASTM E 779 (2003)  | Standard Test Method for Determining Air Leakage Rate by Fan Pressurization  |
| ASTM E1827-96(2002)  | Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door   |

|   |   |
|---|---|
| <b>Builders Hardware Manufacturers Association (BHMA)</b> |   |
| ANSI/BHMA   | The Various BHMA American National Standards  |
| <b>Building Industry Consulting Service International</b> |   |
|   | Telecommunications Distribution Methods Manual (TDMM)   |
|   | Customer-Owned Outside Plant Design Manual (CO-OSP)   |
| <b>Code of Federal Regulations (CFR)</b>                  |   |
| 49 CFR 192  | Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards                                       |
| 10 CFR 430  | Energy Conservation Program for Consumer Products   |
| <b>Consumer Electronics Association</b>                   |   |
| CEA 709.1B  | Control Network Protocol Specification  |
| CEA 709.3   | Free-Topology Twisted-Pair Channel Specification  |
| CEA 852   | Tunneling Component Network Protocols Over Internet Protocol Channels   |
| <b>Electronic Industries Association (EIA)</b>            |   |
| ANSI/EIA/TIA 568  | Structured Cabling Series   |
| ANSI/EIA/TIA 569  | Commercial Building Standard for Telecommunications Pathways and Spaces (includes ADDENDA)                                  |
| ANSI/TIA/EIA-606  | Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings                                   |
| J-STD EIA/TIA 607   | Commercial Building Grounding and Bonding Requirements for Telecommunications   |
| <b>Federal Highway Administration (FHWA)</b>              |   |
|   | Manual on Uniform Traffic Control Devices for Streets and Highways [signage and pavement markings for streets and highways] |
| FHWA-NHI-01-021   | Hydraulic Engineering Circular No. 22, Second Edition, URBAN DRAINAGE DESIGN MANUAL   |

| <b>Illuminating Engineering Society of North America (IESNA)</b>     |  |
|--|--|
| IESNA RP-1   | Office Lighting  |
| IESNA RP-8   | Roadway Lighting   |
| IESNA Lighting Handbook  | Reference and Application  |
| <b>Institute of Electrical and Electronics Engineers Inc. (IEEE)</b> |  |
|  | Standard for Use of the International System of Units (SI): the Modern Metric System   |
| Standard 1100  | Recommended Practice for Powering and Grounding Sensitive Electronic Equipment   |
| <b>International Code Council (ICC)</b>                              |  |
| IBC  | <p>International Building Code</p> <p>Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70.</p> <p>All references in the International Building Code to the International Fuel Gas Code shall be considered to be references to NFPA 54 and NFPA 58.</p> <p>All references in the International Building Code to the International Fire Code and Chapter 9 shall be considered to be references to Unified Facilities Criteria (UFC) 3-600-01.</p> |
| IMC  | <p>International Mechanical Code –</p> <p>Note: For all references to “HEATING AND COOLING LOAD CALCULATIONS”, follow ASHRAE 90.1</p> <p>Note: For all references to “VENTILATION”, follow ASHRAE 62.1</p>   |
| IRC  | International Residential Code   |
| IPC  | International Plumbing Code  |
| IEC  | Energy Conservation Code (IEC) –Applicable only to the extent specifically referenced herein. Refer to Paragraph 5, ENERGY CONSERVATION requirements.  |
| IGC  | International Gas Code - not applicable. Follow NFPA 54, National Fuel Gas Code and NFPA 58, Liquefied Petroleum Gas Code.   |

|   |  |
|---|--|
| <b>International Organization for Standardization (ISO)</b>             |  |
| ISO 6781:1983   | Qualitative detection of thermal irregularities in building envelopes – infrared method  |
| <b>LonMark International (LonMark)</b>                                  |  |
| LonMark Interoperability Guidelines                                     | (available at <a href="http://www.lonmark.org">www.lonmark.org</a> ), including: Application Layer Guidelines, Layer 1-6 Guidelines, and External Interface File (XIF) Reference Guide |
| LonMark Resource Files  | (available at <a href="http://www.lonmark.org">www.lonmark.org</a> ), including Standard Network Variable Type (SNVT) definitions  |
| <b>Metal Building Manufacturers Association (MBMA)</b>                  |  |
|   | Metal Building Systems Manual  |
| <b>Midwest Insulation Contractors Association (MICA)</b>                |  |
|   | National Commercial and Industrial Insulation Standards Manual   |
| <b>National Association of Corrosion Engineers International (NACE)</b> |  |
| NACE RP0169   | Control of External Corrosion on Underground or Submerged Metallic Piping Systems  |
| NACE RP0185   | Extruded, Polyolefin Resin Coating Systems with Adhesives for Underground or Submerged Pipe  |
| NACE RP0285   | Corrosion Control of Underground Storage Tank Systems by Cathodic Protection   |
| NACE RP0286   | Electrical Isolation of Cathodically Protected Pipelines   |
| <b>National Electrical Manufacturers Association (NEMA)</b>             |  |
| <b>National Environmental Balancing Bureau (NEBB)</b>                   |  |
|   | Procedural Standards Procedural Standards for Testing Adjusting Balancing of Environmental Systems   |
| <b>National Fire Protection Association (NFPA)</b>                      |  |
| NFPA 10   | Standard for Portable Fire Extinguishers   |
| NFPA 13   | Installation of Sprinkler Systems  |



|   |   |
|---|---|
| NFPA 13R  | Residential Occupancies up to and Including Four Stories in Height Sprinkler Systems  |
| NFPA 14   | Standard for the Installation of Standpipes and Hose Systems  |
| NFPA 20   | Installation of Centrifugal Fire Pumps  |
| NFPA 24<br>NFPA 25                                      | Standard for the Installation of Private Fire Service Mains and Their Appurtenances [underground fire protection system design]<br><br>Inspection, Testing And Maintenance Of Water-Based Fire Protection Systems |
| NFPA 30   | Flammable and Combustible Liquids Code  |
| NFPA 30A  | Motor Fuel Dispensing Facilities and Repair Garages   |
| NFPA 31   | Installation of Oil Burning Equipment   |
| NFPA 54   | National Fuel Gas Code  |
| NFPA 58   | Liquefied Petroleum Gas Code  |
| NFPA 70   | National Electrical Code  |
| NFPA 72   | National Fire Alarm Code  |
| NFPA 76   | Fire Protection of Telecommunications Facilities  |
| NFPA 80   | Standard for Fire Doors and Fire Windows  |
| NFPA 90a  | Installation of Air Conditioning and Ventilating Systems  |
| NFPA 96   | Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations   |
| NFPA 101  | Life Safety Code  |
| NFPA 780  | Standard for the Installation of Lightning Protection Systems   |
| <b>National Roofing Contractor's Association (NRCA)</b> |   |
|   | Roofing and Waterproofing Manual  |
| <b>National Sanitation Foundation, International</b>    |   |

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| NSF/ANSI Std. 2, 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 36, 37, 51, 52, 59, 169 | Food Equipment Standards   |
| ANSI/UL Std. 73, 197, 471, 621, 763  | Food Equipment Standards   |
| CSA Std. C22.2 No. 109, 120, 195   | Food Equipment Standards   |
| <b>Occupational Safety and Health Administration (OSHA)</b>                                |  |
| Title 29, Part 1926  | OSHA Construction Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction |
| <b>Plumbing and Drainage Institute (PDI)</b>   |  |
| PDI G 101  | Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data                                     |
| PDI WH201  | Water Hammer Arrestors   |
| <b>Precast Concrete Institute</b>  |  |
| PCI Design Handbook  | Precast and Prestressed Concrete   |
| <b>Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)</b>         |  |
| SMACNA HVAC Duct Construction Standards  | HVAC Duct Construction Standards - Metal and Flexible  |
| SMACNA Architectural Manual  | Architectural Sheet Metal Manual   |
| SMACNA HVAC TAB  | HVAC Systems - Testing, Adjusting and Balancing  |
| <b>State/Local Regulations</b>   |  |
|  | State Department of Transportation Standard Specifications for Highway and Bridge Construction   |
|  | Sedimentation and Erosion Control Design Requirements  |
|  | Environmental Control Requirements   |
|  | Storm Water Management Requirements  |

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| <b>Steel Door Institute (SDI)</b>  |   |
| ANSI A250.8/SDI 100  | Standard Steel Doors and Frames   |
| <b>Steel Deck Institute</b>  |   |
|  | SDI Diaphragm Design Manual   |
| <b>Steel Joist Institute</b>   |   |
|  | Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders   |
| <b>Underwriters Laboratories (UL)</b>  |   |
| UL 96A   | Installation Requirements for Lightning Protection Systems  |
| UL 300   | Standard for Safety for Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas   |
| <b>UNITED STATES ACCESS BOARD: U.S. ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD</b> |   |
| ADA and ABA Accessibility Guidelines for Buildings and Facilities                                  | <p>ABA Accessibility Standard for DoD Facilities</p> <p>Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10.</p> <p>Use this reference in lieu of IBC Chapter 11.</p> <p>Excluded are:</p> <p>(a) Facilities, or portions of facilities, on a military installation that are designed and constructed for use exclusively by able-bodied military personnel (See Paragraph 3 for any reference to this exclusion).</p> <p>(b) Reserve and National Guard facilities, or portions of such facilities, owned by or under the control of the Department of Defense, that are designed and constructed for use exclusively by able-bodied military personnel. (See paragraph 3 for any reference to this exclusion).</p> |
| <b>U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES</b>  |   |
|  | FDA National Food Code  |
| <b>U.S. GREEN BUILDING COUNCIL (USGBC)</b>   |   |
| LEED-NC  | Green Building Rating System for New Construction & Major Renovations   |
|  | Application Guide for Multiple Buildings and On-Campus Building   |

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#### 4.2. MILITARY CRITERIA

The project shall conform to the following criteria. Certain design impacts and features due to these criteria are noted for the benefit of the offeror. However, all requirements of the referenced criteria will be applicable, whether noted or not, unless otherwise specified herein.

4.2.1. Energy Policy Act of 2005 (Public Law 109-58) (applies only to the extent specifically implemented in the contract, which may or may not directly cite or reference EPACT)

4.2.2. Executive Order 12770: Metric Usage In Federal Government

(a) Metric design and construction is required except when it increases construction cost. Offeror to determine most cost efficient system of measurement to be used for the project.

4.2.3. TB MED 530: Occupational and Environmental Health Food Sanitation

4.2.4. Unified Facilities Criteria (UFC) 3-410-01FA: Heating, Ventilating, and Air Conditioning - applicable only to the extent specified in paragraph 5, herein.

4.2.5. Deleted.

4.2.6. UFC 3-600-01 Design: Fire Protection Engineering for Facilities. Use the latest edition of the IBC in coordination with this UFC. Use Chapters 3, 6, 7, 33 and UFC 3-600-01. If any conflict occurs between these Chapters and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence. Use UFC 3-600-01 in lieu of IBC Chapters 4, 8,9,10.

4.2.7. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

4.2.8. UFC 4-023-03 Design of Buildings to Resist Progressive Collapse (Use most recent version, regardless of references thereto in other publications)

(a) Note the option to use tie force method or alternate path design for Occupancy Category II.

4.2.9. UFC 4-021-01 Design and O&M: Mass Notification Systems

4.2.10. Technical Criteria for Installation Information Infrastructure Architecture (I3A)

(a) Email: [DetrickISECI3Aguide@conus.army.mil](mailto:DetrickISECI3Aguide@conus.army.mil)

4.2.11. U.S. Army Information Systems Engineering Command (USAISEC) TG for the Integration of SECRET Internet Protocol (IP) Router Network (SIPRNET). See Paragraph 3 for applicability to specific facility type. May not apply to every facility. This is mandatory criteria for those facilities with SIPRNET.

4.2.11.1. Draft Guide Specification for Section 27 05 28 PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATIONS SYSTEMS, found at [https://rfpwizard.cecer.army.mil/HTML/docs/Refs/SECTION\\_270528-v3.pdf](https://rfpwizard.cecer.army.mil/HTML/docs/Refs/SECTION_270528-v3.pdf)

## 5.0 GENERAL TECHNICAL REQUIREMENTS

This paragraph contains technical requirements with general applicability to Army facilities. See also Paragraph 3 for facility type-specific operational, functional and technical requirements. Residential or similar grade finishes and materials are not acceptable for inclusion in these buildings, unless otherwise specifically allowed.

### 5.1. SITE PLANNING AND DESIGN

5.1.1. STANDARDS AND CODES: The site planning and design shall conform to APPLICABLE CRITERIA and to paragraph 6, PROJECT SPECIFIC REQUIREMENTS.

5.1.2. SITE PLANNING OBJECTIVES: Group buildings in configurations that create a sense of community and promote pedestrian use. See paragraph 3 for additional site planning requirements relating to building functions.

5.1.2.1. Provide enclosures and or visual screening devices for Outdoor Utility such as dumpsters, emergency generators, transformers, heating, ventilation, and air conditioning units from streetscape and courtyard views to limit visual impact. Enclosures shall be compatible with the building they serve and accessible by vehicle. The location of dumpsters can have a significant visual impact and should be addressed as part of an overall building design and incorporated in site planning.

5.1.2.2. Where included in the project, dumpster pads shall be concrete (minimum of 8 inches thick on 4 inch base course, unless site conditions dictate more conservative requirements) and directly accessible by way of a paved service drive or parking lot with adequate overhead clearance for collection vehicles. Provide space at dumpster areas for recycling receptacles. Coordinate with Installation on recycling receptacle types, sizes and access requirements and provide space at dumpster areas to accommodate them.

5.1.2.3. Vehicular Circulation. Apply design vehicle templates provided by the American Association of State Highway and Transportation Officials (AASHTO) to the site design. The passenger car class includes passenger cars and light trucks, such as vans and pick-ups. The passenger car template is equivalent to the non-organizational – privately owned vehicle (POV). The truck class template includes single-unit trucks, recreation vehicles, buses, truck tractor-semi-trailer combinations, and trucks or truck tractors with semi-trailers in combination with full trailers. Provide vehicle clearances required to meet traffic safety for emergency vehicles, service vehicles, and moving vans. Provide required traffic control signage Site entrances and site drive aisles shall maximize spacing between drives, incorporate right-angle turns, and limit points of conflict between traffic. Design Services Drives to restrict access to unauthorized vehicles by removable bollards, gates, or other barriers to meet Anti-Terrorism/Force Protection (ATFP) requirements. Orient service drives to building entrances other than the primary pedestrian entry at the front of the building.

5.1.2.4. Provide Emergency Vehicle Access around the facility and shall be in accordance with AT/FP requirements. Maintain a 33-foot clear zone buffer for emergency vehicles, designed to prevent other vehicles from entering the AT/FP standoff to the building.

5.1.2.5. Clear and grub all trees and vegetation necessary for construction; but, save as many trees as possible. Protect trees to be saved during the construction process from equipment.

5.1.2.6. Stormwater Management. Employ design and construction strategies (Best Management Practices) that reduce stormwater runoff, reduce discharges of polluted water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume and duration of flow to the maximum extent practicable. See paragraph 6, PROJECT SPECIFIC requirements for additional information.

5.1.3. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy.

5.1.4. EXISTING UTILITIES: Base utilities maps and capacities for this site are included as part of this RFP. See paragraph 6 for more detailed information.

### 5.2. SITE ENGINEERING

5.2.1. STANDARDS AND CODES: The site engineering shall conform to APPLICABLE CRITERIA.

5.2.2. SOILS:

5.2.2.1. A report has been prepared to characterize the subsurface conditions at the project site and is **appended to these specifications**. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters in which to base the contractor's design. If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, the Contractor shall perform it under the direction of a licensed geotechnical engineer. There will be no separate payment for the cost of additional tests. If differences between the Contractor's additional subsurface investigation and the government provided soils report or the reasonably expected conditions require material revisions in the design, an equitable adjustment may be made, in accordance with the provisions of the Differing Site Conditions clause. The basis for the adjustment would be the design and construction appropriate for the conditions described in the Government furnished report or the reasonably expected conditions, in comparison with any changes required by material differences in the actual conditions encountered, in accordance with the terms of contract clause Differing Site Conditions.

5.2.2.2. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal, as described in Section 01 33 16, *Design After Award*.

5.2.3. VEHICLE PAVEMENTS: (as applicable to the project)

5.2.3.1. Design procedures and materials shall conform to one of the following: 1) the USACE Pavement Transportation Computer Assisted Structural Engineering (PCASE) program, 2) American Association of State Highway and Transportation Officials (AASHTO) or, 3) the applicable state Department of Transportation standards in which the project is located. See paragraph 5.2.2.2 and Section 01 33 16 for required information for the Contractor's geotechnical evaluation report. The minimum flexible pavement section shall consist of 2 inches of asphalt and 6 inches of base or as required by the pavement design, whichever is greater, unless specifically identified by the Government to be a gravel road. Design roads and parking areas for a life expectancy of 25 years with normal maintenance. Parking area for tactical vehicles (as applicable to the project) shall be Portland Cement Concrete (PCC) rigid pavement design. For concrete pavements, submit joint layout plan for review and concurrence. Design pavements for military tracked vehicles (as applicable to the project) IAW USACE PCASE. Traffic estimates for each roadway area will be as shown on the drawings or listed in Section 01 10 00 Paragraph 6.4.4. Pavement markings and traffic signage shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices.

5.2.3.2. Parking Requirements.

(a) All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces.

(b) Design POV parking spaces for the type of vehicles anticipated, but shall be a minimum of 9 ft by 18 ft for POVs, except for two wheel vehicles.

5.2.3.3. Sidewalks. Design the network of walks throughout the complex (where applicable) to facilitate pedestrian traffic among facilities, and minimize the need to use vehicles. Incorporate sidewalks to enhance the appearance of the site development, while creating a sense of entry at the primary patron entrances to the buildings. Minimum sidewalk requirements are in Paragraph 3, where applicable and/or paragraph 6 and/or site plans, where applicable..

5.2.4. CATHODIC PROTECTION: Provide cathodic protection systems for all underground metallic systems and metallic fittings/portions of non-metallic, underground systems, both inside and outside the building 5 foot line that are subject to corrosion. Coordinate final solutions with the installation to insure an approach that is consistent with installation cathodic protection programs.

5.2.5. UTILITIES: See paragraph 6.4.6 for specific information on ownership of utilities and utility requirements. Meter all utilities (gas, water, and electric, as applicable) to each facility. For Government owned utilities, install meters that are wireless data transmission capable as well as have a continuous manual reading option. All meters will be capable of at least hourly data logging and transmission and provide consumption data for gas, water, and

electricity. Gas and electric meters will also provide demand readings based on consumption over a maximum of any 15 minute period. Configure all meters to transmit at least daily even if no receiver for the data is currently available at the time of project acceptance. For privatized utilities, coordinate with the privatization utility(ies) for the proper meter base and meter installation.

5.2.6. PERMITS: The CONTRACTOR shall be responsible for obtaining all permits (local, state and federal) required for design and construction of all site features and utilities.

5.2.7. IRRIGATION. Landscape irrigation systems, if provided, shall comply with the following:

5.2.7.1. Irrigation Potable Water Use Reduction. Reduce irrigation potable water use by 100 percent using LEED credit WE1.1 baseline (no potable water used for irrigation), except where precluded by other project requirements.

5.2.8. EPA WATERSENSE PRODUCTS AND CONTRACTORS. Except where precluded by other project requirements, use EPA WaterSense labeled products and irrigation contractors that are certified through a WaterSense labeled program where available.

### 5.3. ARCHITECTURE AND INTERIOR DESIGN:

This element will be evaluated per APPLICABLE CRITERIA under the quality focus.

5.3.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.3.2. GENERAL: Overall architectural goal is to provide a functional, quality, visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.3.3. COMPUTATION OF AREAS: See APPENDIX Q for how to compute gross and net areas of the facility(ies).

5.3.4. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation. Where appropriate, reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. When practical, exterior materials, roof forms, and detailing shall be compatible with the surrounding development and adjacent buildings on the Installation and follow locally established architectural themes. Use durable materials that are easy to maintain. Exterior colors shall conform to the Installation requirements. See paragraph 6.

5.3.4.1. Building Numbers: Permanently attach exterior signage on two faces of each building indicating the assigned building number or address. Building number signage details and locations shall conform to Appendix H, Exterior Signage.

### 5.3.5. BUILDING INTERIOR

5.3.5.1. Space Configuration: Arrange spaces in an efficient and functional manner in accordance with area adjacency matrices.

5.3.5.2. Surfaces: Appearance retention is the top priority for building and furniture related finishes. Provide low maintenance, easily cleaned room finishes that are commercially standard for the facility occupancy specified, unless noted otherwise.

5.3.5.3. Color: The color, texture and pattern selections for the finishes of the building shall provide an aesthetically pleasing, comfortable, easily maintainable and functional environment for the occupants. Coordinate the building colors and finishes for a cohesive design. Select colors appropriate for the building type. Use color, texture and pattern to path or way find through the building. Trendy colors that will become dated shall be limited to non-permanent finishes such as carpet and paint. Select finishes with regards to aesthetics, maintenance, durability, life safety and image. Limit the number of similar colors for each material. Use medium range colors for ceramic and porcelain tile grout to help hide soiling. Plastic laminate and solid surface materials shall have patterns that are mottled, flecked or speckled. Coordinate finish colors of fire extinguisher cabinets, receptacle bodies and plates, fire alarms / warning lights, emergency lighting, and other miscellaneous items with the building interior. Match color of equipment items on ceilings (speakers, smoke detectors, grills, etc.) the ceiling color.

5.3.5.4. Circulation: Circulation schemes must support easy way finding within the building.

5.3.5.5. Signage: Provide interior signage for overall way finding and life safety requirements. A comprehensive interior plan shall be from one manufacturer. Include the following sign types: (1) Lobby Directory, (2) Directional Signs; (3) Room Identification Signs; (4) Building Service Signs; (5) Regulatory Signs; (6) Official and Unofficial Signs (7) Visual Communication Boards (8) NO SMOKING signage that conveys building smoking policy. Use of emblems or logos may also be incorporated into the signage plan.

5.3.5.6. Window Treatment: Provide interior window treatments with adjustable control in all exterior window locations for control of day light coming in windows or privacy at night. Maintain uniformity of treatment color and material to the maximum extent possible within a building.

5.3.5.7. Casework: Unless, otherwise specified, all casework for Cabinetry and cases shall be "custom grade", as described in the AWI Quality Standards.

#### 5.3.6. COMPREHENSIVE INTERIOR DESIGN

5.3.6.1. Comprehensive Interior Design includes the integration of a Structural Interior Design (SID) and a Furniture, Fixtures and Equipment (FF&E) design and package. SID requires the design, selection and coordination of interior finish materials that are integral to or attached to the building structure. Completion of a SID involves the selection and specification of applied finishes for the building's interior features including, but not limited to, walls, floors, ceilings, trims, doors, windows, window treatments, built-in furnishings and installed equipment, lighting, and signage. The SID package includes finish schedules, finish samples and any supporting interior elevations, details or plans necessary to communicate the building finish design and build out. The SID also provides basic space planning for the anticipated FF&E requirements in conjunction with the functional layout of the building and design issues such as life safety, privacy, acoustics, lighting, ventilation, and accessibility. See Section 01 33 16 for SID design procedures.

5.3.6.2. The FF&E design and package includes the design, selection, color coordination and of the required furnishing items necessary to meet the functional, operational, sustainability, and aesthetic needs of the facility coordinated with the interior finish materials in the SID. The FF&E package includes the specification, procurement documentation, placement plans, ordering and finish information on all freestanding furnishings and accessories, and a cost estimate. Coordinate the selection of furniture style, function and configuration with the defined requirements. Examples of FF&E items include, but are not limited to workstations, seating, files, tables, beds, wardrobes, draperies and accessories as well as marker boards, tack boards, and presentation screens. Criteria for furniture selection include function and ergonomics, maintenance, durability, sustainability, comfort and cost. See Section 01 33 16 for FFE design procedures.

#### 5.4. STRUCTURAL DESIGN

5.4.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: The structural system must be compatible with the intended functions and components that allows for future flexibility and reconfigurations of the interior space. Do not locate columns, for instance, in rooms requiring visibility, circulation or open space, including, but not limited to entries, hallways, common areas, classrooms, etc. Select an economical structural system based upon facility size, projected load requirements and local availability of materials and labor. Base the structural design on accurate, site specific geotechnical information and anticipated loads for the building types and geographical location. Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting the type of cement and admixtures used in concrete, the concrete cover on reinforcing steel, the coatings on structural members, expansion joints, the level of corrosion protection, and the structural systems. Analyze, design and detail each building as a complete structural system. Design structural elements to preclude damage to finishes, partitions and other frangible, non-structural elements to prevent impaired operability of moveable components; and to prevent cladding leakage and roof ponding. Limit deflections of structural members to the allowable of the applicable material standard, e.g., ACI, AISC, Brick Industry Association, etc. When modular units or other pre-fabricated construction is used or combined with stick-built construction, fully coordinate and integrate the overall structural design between the two different or interfacing construction types. If the state that the project is located in requires separate, specific licensing for structural engineers (for instance, such as in Florida, California and others), then the structural engineer designer of record must be registered in that state.



5.4.3. LOADS: See paragraph 3 for facility specific (if applicable) and paragraph 6 for site and project specific structural loading criteria. Unless otherwise specified in paragraph 6, use Exposure Category C for wind. If not specified, use Category C unless the Designer of Record can satisfactorily justify another Exposure Category in its design analysis based on the facility Master Plan. Submit such exceptions for approval as early as possible and prior to the Interim Design Submittal in Section "Design After Award". Design the ancillary building items, e.g. doors, window jambs and connections, overhead architectural features, systems and equipment bracing, ducting, piping, etc. for gravity, seismic, lateral loads and for the requirements of UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings. Ensure and document that the design of glazed items includes, but is not limited to, the following items under the design loads prescribed in UFC 4-010-01:

- (a) Supporting members of glazed elements, e.g. window jamb, sill, header
- (b) Connections of glazed element to supporting members, e.g. window to header
- (c) Connections of supporting members to each other, e.g. header to jamb
- (d) Connections of supporting members to structural system, e.g. jamb to foundation.

5.4.4. TERMITE TREATMENT: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals and licensed applicator firm.

## 5.5. THERMAL PERFORMANCE

5.5.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.5.2. BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT. Design and construct the building envelope for office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings. The use of painted interior walls is not an acceptable air barrier method.

5.5.2.1. Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints.

5.5.2.2. The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3" wg (0.02 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E 2178

5.5.2.3. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

5.5.2.4. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure.

5.5.2.5. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly.

5.5.2.6. The air barrier must be durable to last the anticipated service life of the assembly.

5.5.2.7. Do not install lighting fixtures with ventilation holes through the air barrier

5.5.2.8. Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers at elevator shafts. Coordinate the motorized elevator hoistway vent damper(s) with the Fire Protection System design in paragraph 5.10. Ensure that the damper(s) is accessible to facilitate regular inspection and maintenance.

5.5.2.9. Damper and control to close all ventilation or make-up air intakes and exhausts, , etc., when leakage can occur during inactive periods. Atrium smoke exhaust and intakes shall only open when activated per IBC and other applicable Fire Code requirements.

5.5.2.10. Compartmentalize garages under buildings by providing air-tight vestibules at building access points.

5.5.2.11. Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.5.2.12. Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

(a) Develop an Air Barrier Quality Control plan to assure that a competent air barrier inspector/specialist inspects the critical components prior to them being concealed. At a minimum, three onsite inspections are required during construction to assure the completeness of the construction and design.

(b) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft<sup>2</sup> at a pressure differential of 0.3" w.g.(75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using both pressurization and depressurization.. Divide the volume of air leakage in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft<sup>2</sup> @ 0.3" w.g. (L/s.m<sup>2</sup> @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

(c) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above.

(d) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

## 5.6. PLUMBING

5.6.1. STANDARDS AND CODES: The plumbing system shall conform to APPLICABLE CRITERIA.

5.6.2. PRECAUTIONS FOR EXPANSIVE SOILS: Where expansive soils are present, include design features for underslab piping systems and underground piping serving chillers, cooling towers, etc, to control forces resulting from soil heave. Some possible solutions include, but are not necessarily limited to, features such as flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings. For structurally supported slabs, suspend piping from the structure with adequate space provided below the pipe for the anticipated soil movement.

5.6.3. HOT WATER SYSTEMS: For Hot Water heating and supply, provide a minimum temp of 140 Deg F in the storage tank and a maximum of 110 Deg F at the fixture, unless specific appliances or equipment specifically require higher temperature water supply.

5.6.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in paragraph 3, design in accordance with ASHRAE Handbook Series (appropriate Chapters), ASHRAE Standard 90.1, and the energy conservation requirements of the contract. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.6.5. JANITOR CLOSETS: In janitor spaces/room/closets, provide at minimum, a service sink with heavy duty shelf and wall hung mop and broom rack(s).

5.6.6. FLOOR DRAINS: As a minimum, provide floor drains in mechanical rooms and areas, janitor spaces/rooms/closets and any other area that requires drainage from fixtures or equipment, drain downs, condensate, as necessary.

5.6.7. URINALS: Urinals shall be vitreous china, wall-mounted, wall outlet, non-water using, with integral drain line connection, and with sealed replaceable cartridge or integral liquid seal trap. Either type shall use a biodegradable liquid to provide the seal and maintain a sanitary and odor-free environment. Install, test and maintain in accordance with manufacturer's recommendations. Slope the sanitary sewer branch line for non-water use urinals a minimum of 1/4 inch per foot. Do not use copper tube or pipe for drain lines that connect to the urinal. Manufacturer shall provide an operating manual and on-site training to installation operations personnel for the proper care and maintenance of the urinal. For complexes, non-water using urinals are not required for barracks type spaces.

5.6.8. BUILDING WATER USE REDUCTION. Reduce building potable water use in each building 30 percent using IPC fixture performance requirements baseline.

5.6.9. Do not use engineered vent or Sovent® type drainage systems.

5.6.10. Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air, and where condensate drip will cause damage or create a hazard, insulate plumbing piping with a vapor barrier type of insulation to prevent condensation. Do not locate water or drainage piping over electrical wiring or equipment unless adequate protection against water (including condensation) damage is provided. Insulation alone is not adequate protection against condensation. Follow ASHRAE Fundamentals Chapter 23, Insulation for Mechanical Systems, IMC paragraph 1107 and International Energy Conservation Code for pipe insulation requirements.

5.6.11. Cover all drain, waste and vent piping to prevent mortar or other debris from being flushed down and blocking pipes during such construction activities.

## 5.7. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.7.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.7.2. MATERIALS AND EQUIPMENT: Materials, equipment and devices shall, as a minimum, meet the requirements of Underwriters Laboratories (UL) where UL standards are established for those items. Wiring for branch circuits shall be copper. Motors larger than one-half horsepower shall be three phase. All electrical systems shall be pre-wired and fully operational unless otherwise indicated. Wall mounted electrical devices (power receptacles, communication outlets and CATV outlets) shall have matching colors, mounting heights and faceplates.

5.7.3. POWER SERVICE: Primary service from the base electrical distribution system to the pad-mounted transformer and secondary service from the transformer to the building service electrical equipment room shall be underground. See paragraph 6 for additional site electrical requirements.

5.7.3.1. Spare Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.7.4. TELECOMMUNICATION SERVICE: Connect the project's facilities to the Installation telecommunications (voice and data) system through the outside plant (OSP) telecommunications underground infrastructure cabling system per the I3A Criteria. Connect to the OSP cabling system from each facility main cross connect located in the telecommunications room.

5.7.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society of North America (IESNA), the National Energy Policy Act and Energy Star requirements for lighting products..

5.7.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

- (b) High Efficiency Fluorescent Lighting: Utilize NEMA premium electronic ballasts and energy efficient fluorescent lamps with a Correlated Color Temperature (CCT) of 4100K. Linear fluorescent and compact fluorescent fixtures shall have a Color Rendering Index of (CRI) of 87 or higher. Fluorescent lamps shall be the low mercury type qualifying as non-hazardous waste upon disposal. Do not use surface mounted fixtures on acoustical tile ceilings. Provide an un-switched fixture with emergency ballast shall be provided at each entrance to the building.
- (c) Solid State Lighting: Fixtures shall provide lighting with a minimum Correlated Color Temperature (CCT) of 4100K and shall have a Color Rendering Index of (CRI) of 75 or higher. Verify performance of the light producing solid state components by a test report in compliance with the requirements of IESNA LM 80. Verify performance of the solid state light fixtures by a test report in compliance with the requirements of IESNA LM 79. Provide lab results by a NVLAP certified laboratory. The light producing solid state components and drivers shall have a life expectancy of 50,000 operating hours while maintaining at least 70% of original illumination level. Provide a complete five year warranty for fixtures.
- (d) Metal Halide Lighting (where applicable): Metal Halide lamp fixtures in the range of 150-500 Watts shall be pulse start type and have a minimum efficiency rating of 88%.
- (e) Lighting Controls: ANSI/ASHRAE/IESNA 90.1 has specific lighting controls requirements. Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (classrooms, conference rooms) to promote the productivity, comfort and well being of the building occupants. In office spaces, the preferred lighting should be a 30 FC ambient lighting level with occupancy sensor controlled task lighting in the work spaces to provide a composite lighting level of 50 FC on the working surfaces. Consider incorporating daylighting techniques for the benefit of reducing lighting energy requirements while improving the quality of the indoor spaces. If daylight strategies are used, additional coordination is required with the architect and mechanical engineer. Additionally, incorporate electric lighting controls to take advantage of the potential energy savings.
- (f) Exterior Lighting: See paragraph 6.9 for site specific information, if any, on exterior lighting systems. Minimize light pollution and light trespass by not over lighting and use cut-off type exterior luminaries.

5.7.6. TELECOMMUNICATION SYSTEM: Building telecommunications cabling systems (BCS) and OSP telecommunications cabling system shall conform to APPLICABLE CRITERIA, including but not limited to I3A Technical Criteria. An acceptable BCS encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, conduits, grounding, and labeling.. Items included under OSP infrastructure encompass, but are not limited to, manhole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, cable vaults, and copper and FO entrance cable.

5.7.6.1. Design, install, label and test all telecommunications systems in accordance with the I3A Criteria and ANSI/TIA/EIA 568, 569, and 606 standards. A Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) with at least 2 yrs related experience shall develop and stamp telecommunications design, and prepare the test plan. See paragraph 5.8.2.5 for design of environmental systems for Telecommunications Rooms.

5.7.6.2. The installers assigned to the installation of the telecommunications system or any of its components shall be regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. Key personnel; i.e., supervisors and lead installers assigned to the installation of this system or any of its components shall be BICSI Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

5.7.6.3. Perform a comprehensive end to end test of all circuits to include all copper and fiber optic cables upon completion of the BCS and prior to acceptance of the facility. Provide adequate advanced notification to the COR to allow COR and Installation personnel attendance The BCS circuits include but are not limited to all copper and fiber optic(FO) entrance cables, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, and workstation outlets. Test in accordance with ANSI/EIA/TIA 568 standards. Use test instrumentation that meets or exceeds the standard. Submit the official test report to include test procedures, parameters tested, values, discrepancies and corrective actions in electronic format. Test and accomplish all

necessary corrective actions to ensure that the government receives a fully operational, standards based, code compliant telecommunications system.

5.7.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

#### 5.8. HEATING, VENTILATING, AND AIR CONDITIONING

5.8.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.8.2. DESIGN CONDITIONS.

5.8.2.1. Outdoor and indoor design conditions shall be in accordance with UFC 3-410-01FA. Outdoor air and exhaust ventilation requirements for indoor air quality shall be in accordance with ASHRAE 62.1. All Buildings with minimum LEED Silver requirement (or better) will earn LEED Credit EQ 7.1, Thermal Comfort-Design., except where precluded by other project requirements. Where the contract specifies indoor design temperature , airflow, humidity conditions, etc., use those parameters.

5.8.2.2. High Humidity Areas: Design HVAC systems in geographical areas meeting the definition for high humidity in UFC 3-410-01FA to comply with the special criteria therein for humid areas.

5.8.2.3. Cooling equipment may be oversized by up to 15 percent to account for recovery from night setback. Heating equipment may be oversized by up to 30 percent to account for recovery from night setback. Design single zone systems and multi-zone systems to maintain an indoor design condition of 50% relative humidity for cooling only. For heating only where the indoor relative humidity is expected to fall below 20% for extended periods, add humidification to increase the indoor relative humidity to 30%. Provide ventilation air from a separate dedicated air handling unit (DOAU) for facilities using multiple single zone fan-coil type HVAC systems. Do not condition outside air through fan coil units. Avoid the use of direct expansion cooling coils in air handling units with constant running fans that handle outside air.

5.8.2.4. Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.8.2.5. Environmental Requirements for Telecommunications Rooms and Telecommunications Equipment Rooms, (including SIPRNET ROOMS, where applicable for specific facility type). Comply with ANSI/EIA/TIA 569 (including applicable Addenda). Maintain environmental conditions at the Class 1 and 2 Recommended Operating Environment. Before being introduced into the room, filter and pre-condition outside air to remove particles with the minimum MERV filtration quality shown in the ASHRAE HVAC Applications, Chapter 17. Maintain rooms under positive pressure relative to surrounding spaces. Design computer room air conditioning units specifically for telecommunications room applications. Build and test units in accordance with the requirements of ANSI/ASHRAE Standard 127. A complete air handling system shall provide ventilation, air filtration, cooling and dehumidification, humidification (as determined during the design phase), and heating. The system shall be independent of other facility HVAC systems and shall be required year round.

5.8.2.6. Fire dampers: dynamic type with a dynamic rating suitable for the maximum air velocity and pressure differential to which the damper is subjected. Test each fire damper with the air handling and distribution system running.

5.8.3. BUILDING AUTOMATION SYSTEM. Provide a Building Automation System consisting of a building control network , and integrate the building control network into the UMCS as specified.

The building control network shall be a single complete non-proprietary Direct Digital Control (DDC) system for control of the heating, ventilating and air conditioning (HVAC) systems as specified herein. The building control network shall be an Open implementation of LONWORKS® technology using ANSI/EIA 709.1B as the only communications protocol and use only LonMark Standard Network Variable Types (SNVTs), as defined in the LonMark® Resource Files, for communication between DDC Hardware devices to allow multi-vendor interoperability.

5.8.3.1. The building automation system shall be open in that it is designed and installed such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without further dependence on the original Contractor. This includes, but is not limited to the following:

- (a) Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- (b) Necessary documentation (including rights to documentation and data), configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the Government such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

5.8.3.2. All DDC Hardware shall:

- (a) Be connected to a TP/FT-10 ANSI/EIA 709.3 control network.
- (b) Communicate over the control network via ANSI/EIA 709.1B exclusively.
- (c) Communicate with other DDC hardware using only SNVTs
- (d) Conform to the LonMark® Interoperability Guidelines.
- (e) Be locally powered; link power (over the control network) is not acceptable.
- (f) Be fully configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself to support the application. All settings and parameters used by the application shall be configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself
- (g) Provide input and output SNVTs required to support monitoring and control (including but not limited to scheduling, alarming, trending and overrides) of the application. Required SNVTs include but are not limited to: SNVT outputs for all hardware I/O, SNVT outputs for all setpoints and SNVT inputs for override of setpoints.
- (h) To the greatest extent practical, not rely on the control network to perform the application..

5.8.3.3. Controllers shall be Application Specific Controllers whenever an ASC suitable for the application exists. When an ASC suitable for the application does not exist use programmable controllers or multiple application specific controllers.

5.8.3.4. Application Specific Controllers shall be LonMark Certified whenever a LonMark Certified ASC suitable for the application exists. For example, VAV controllers must be LonMark certified.

5.8.3.5. Application Specific Controllers (ASCs) shall be configurable via an LNS plug-in whenever t an ASC with an LNS plug-in suitable for the application exists.

5.8.3.6. Each scheduled system shall accept a network variable of type SNVT\_occupancy and shall use this network variable to determine the occupancy mode. If the system has not received a value to this network variable for more than 60 minutes it shall default to a configured occupancy schedule.

5.8.3.7. Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.8.3.8. Not Used

5.8.3.9. Perform all necessary actions needed to fully integrate the building control system. These actions include but are not limited to:

- Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting.
- Install IP routers or ANSI/CEA-852 routers as needed to connect the building control network to the UMCS IP network. Routers shall be capable of configuration via DHCP and use of an ANSI/CEA-852 configuration server but shall not rely on these services for configuration. All communication between the UMCS and building networks shall be via the ANSI/CEA-709.1B protocol over the IP network in accordance with ANSI/CEA-852.

5.8.3.10. Provide the following to the Government for review prior to acceptance of the system:

- The latest version of all software and user manuals required to program, configure and operate the system.
- Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum:
  - Device address and NodeID.
  - Input and Output SNVTs including SNVT Name, Type and Description.
  - Hardware I/O, including Type (AI, AO, BI, BO) and Description.
  - Alarm information including alarm limits and SNVT information.
  - Supervisory control information including SNVTs for trending and overrides.
  - Configuration parameters (for devices without LNS plug-ins) Example Points Schedules are available at <https://eko.usace.army.mil/fa/besc/>
- Riser diagram of the network showing all network cabling and hardware. Label hardware with ANSI.CEA-709.1 addresses, IP addresses, and network names.
- Control System Schematic diagram and Sequence of Operation for each HVAC system.
- Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.
- LONWORKS® Network Services (LNS®) database for the completed system.
- Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative

**Table 5-1: QC Checklist**

5.8.3.11. Perform a Performance Verification Test (PVT) under Government supervision prior to system acceptance. During the PVT demonstrate that the system performs as specified, including but not limited to demonstrating that the system is Open and correctly performs the Sequences of Operation.

5.8.3.12. Provide a 1 year unconditional warranty on the installed system and on all service call work. The warranty shall include labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition.

5.8.3.13. Provide training at the project site on the installed building system. Upon completion of this training each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware, architecture and operation of the system.

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5.8.4. TESTING, ADJUSTING AND BALANCING. Test and balance air and hydronic systems, using a firm certified for testing and balancing by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or the Testing Adjusting, and Balancing Bureau (TABB). The prime contractor shall hire the TAB firm directly, not through a subcontractor. Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practicable to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, the TAB Specialist shall develop TAB procedures. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are mandatory.

5.8.5. COMMISSIONING: Commission all HVAC systems and equipment, including controls, and all systems requiring commissioning for LEED Enhanced commissioning, in accordance with ASHRAE Guideline 1.1, ASHRAE Guideline 0 and LEED. Do not use the sampling techniques discussed in ASHRAE Guideline 1.1 and in ASHRAE Guideline 0. Commission 100% of the HVAC controls and equipment. Hire the Commissioning Authority (CA), certified as a CA by AABC, NEBB, or TABB, as described in Guideline 1.1. The CA will be an independent subcontractor and not an employee of the Contractor nor an employee or subcontractor of any other subcontractor

on this project, including the design professionals (i.e., the DOR or their firm(s)). The CA will communicate and report directly to the Government in execution of commissioning activities. The Contracting Officer's Representative will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0. All buildings with Minimum LEED Silver (or better) requirement will earn LEED Credit EA3 Enhanced Commissioning.

## 5.9. ENERGY CONSERVATION

5.9.1. The building including the building envelope, HVAC systems, service water heating, power, and lighting systems shall meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.2. Design all building systems and elements to meet the minimum requirements of ANSI/ASHRAE/IESNA 90.1. Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 40% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.3. Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the type product. The term "Energy Star product" means a product that is rated for energy efficiency under an Energy Star program. The term "FEMP designated product" means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

5.9.4. Solar Hot Water Heating. Provide at least 30% of the domestic hot water requirements through solar heating methodologies, unless the results of a Life Cycle Cost Analysis (LCCA) developed utilizing the Building Life Cycle Cost Program (BLCC) which demonstrates that the solar hot water system is not life cycle cost effective in comparison with other hot water heating systems. The type of system will be established during the contract or task order competition and award phase, including submission of an LCCA for government evaluation to justify non-selection of solar hot water heating. The LCCA uses a study period of 25 years and the Appendix K utility cost information. The LCCA shall include life cycle cost comparisons to a baseline system to provide domestic hot water without solar components, analyzing at least two different methodologies for providing solar hot water to compare against the baseline system.

5.9.5. Process Water Conservation. When potable water is used to improve a building's energy efficiency, employ lifecycle cost effective water conservation measures, except where precluded by other project requirements.

5.9.6. Renewable Energy Features. The Government's goal is to implement on-site renewable energy generation for Government use when lifecycle cost effective. See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

## 5.10. FIRE PROTECTION

5.10.1. STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.10.2. Inspect and test all fire suppression equipment and systems, fire pumps, fire alarm and detection systems and mass notification systems in accordance with the applicable NFPA standards. The fire protection engineer of record shall witness final tests. The fire protection engineer of record shall certify that the equipment and systems are fully operational and meet the contract requirements. Two weeks prior to each final test, the contractor shall notify, in writing, the installation fire department and the installation public work representative of the test and invite them to witness the test.

5.10.3. Fire Extinguisher Cabinets: Provide fire extinguisher cabinets and locations for hanging portable fire extinguishers in accordance with NFPA 10 Standard for Portable Fire Extinguishers. The Government will furnish and install portable fire extinguishers, which are personal property, not real property installed equipment.



5.10.4. Fire alarm and detection system: Required fire alarm and detection systems shall be the addressable type. Fire alarm initiating devices, such as smoke detectors, heat detectors and manual pull stations shall be addressable. When the system is in alarm condition, the system shall annunciate the type and location of each alarm initiating device. Sprinkler water flow alarms shall be zoned by building and by floor. Supervisory alarm initiating devices, such as valve supervisory switches, fire pump running alarm, low-air pressure on dry sprinkler system, etc. shall be zoned by type and by room location.

5.10.5. Roof Access: Paragraph 2-9 of UFC 3-600-01 Fire Protection for Facilities will be modified in the next update to that UFC. Pending revision, comply with roof access and stairway requirements in accordance with the International Building Code. Where roof access is required by the IBC or other criteria, comply with UFC 4-010-01, Anti-Terrorist Force Protection, Standard 14. "Roof Access".

5.10.6. Fire Protection Engineer Qualifications: In accordance with UFC 3-600-01, FIRE PROTECTION ENGINEERING FOR FACILITIES, the fire protection engineer of record shall be a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES), or a registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

## 5.11. SUSTAINABLE DESIGN

5.11.1. STANDARDS AND CODES: Sustainable design shall conform to APPLICABLE CRITERIA. See paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project. The LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects (AGMBC) applies to all projects. Averaging may be used for LEED compliance as permitted by the AGMBC but is restricted to only those buildings included in this project. Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and BUILDING WATER USE REDUCTION.

5.11.2. LEED RATING, REGISTRATION, VALIDATION AND CERTIFICATION: See Paragraph PROJECT-SPECIFIC REQUIREMENTS for project minimum LEED rating/achievement level, for facilities that are exempt from the minimum LEED rating, for LEED registration and LEED certification requirements and for other project-specific information and requirements.

5.11.2.1. Innovation and Design Credits. LEED Innovation and Design (ID) credits are acceptable only if they are supported by formal written approval by GBCI (either published in USGBC Innovation and Design Credit Catalog or accompanied by a formal ruling from GBCI). LEED ID credits that require any Owner actions or commitments are acceptable only when Owner commitment is indicated in paragraph PROJECT-SPECIFIC REQUIREMENTS or Appendix LEED Project Credit Guidance

5.11.3. OPTIMIZE ENERGY PERFORMANCE. : Project must earn, as a minimum, the points associated with compliance with paragraph ENERGY CONSERVATION. LEED documentation differs from documentation requirements for paragraph ENERGY CONSERVATION and both must be provided. For LEED-NC v2.2 projects you may substitute ASHRAE 90.1 2007 Appendix G in its entirety for ASHRAE 90.1 2004 in accordance with USGBC Credit Interpretation Ruling dated 4/23/2008.

5.11.4. COMMISSIONING. See paragraph 5.8.5 COMMISSIONING for commissioning requirements. USACE templates for the required Basis of Design document and Commissioning Plan documents are available at <http://en.sas.usace.army.mil> (click on Engineering Criteria) and may be used at Contractor's option.

5.11.5. DAYLIGHTING. Except where precluded by other project requirements, do the following in at least 75 percent of all spaces occupied for critical visual tasks: achieve a 2 percent glazing factor (calculated in accordance with LEED credit EQ8.1) OR earn LEED Daylighting credit, provide appropriate glare control and provide either automatic dimming controls or occupant-accessible manual lighting controls.

5.11.6. LOW-EMITTING MATERIALS. Except where precluded by other project requirements, use materials with low pollutant emissions, including but not limited to composite wood products, adhesives, sealants, interior paints and finishes, carpet systems and furnishings,

5.11.7. CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT. Except where precluded by other project requirements, earn LEED credit EQ 3.1 Construction IAQ Management Plan, During Construction and credit EQ 3.2 Construction IAQ Management Plan, Before Occupancy.

5.11.8. RECYCLED CONTENT. In addition to complying with section RECYCLED/RECOVERED MATERIALS, earn LEED credit MR4.1, Recycled Content, 10 percent except where precluded by other project requirements.

5.11.9. BIOBASED AND ENVIRONMENTALLY PREFERABLE PRODUCTS. Except where precluded by other project requirements, use materials with biobased content, materials with rapidly renewable content, FSC certified wood products and products that have a lesser or reduced effect on human health and the environment over their lifecycle to the maximum extent practicable.

5.11.10. FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM (FB4P). The Farm Security and Rural Investment Act (FSRIA) of 2002 required the U.S. Department of Agriculture (USDA) to create procurement preferences for biobased products that are applicable to all federal procurement (to designate products for biobased content). For all designated products that are used in this project, meet USDA biobased content rules for them except use of a designated product with USDA biobased content is not required if the biobased product (a) is not available within a reasonable time, (b) fails to meet performance standard or (c) is available only at an unreasonable price. For biobased content product designations, see <http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx>.

5.12. CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT: Achievement of 50% diversion, by weight, of all non-hazardous C&D waste debris is required. Reuse of excess soils, recycling of vegetation, alternative daily cover, and wood to energy are not considered diversion in this context, however the Contractor must track and report it. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.13. SECURITY (ANTI-TERRORISM STANDARDS): Unless otherwise specified in Project Specific Requirements, only the minimum protective measures as specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01, are required for this project. The element of those standards that has the most significant impact on project planning is providing protection against explosives effects. That protection can either be achieved using conventional construction (including specific window requirements) in conjunction with establishing relatively large standoff distances to parking, roadways, and installation perimeters or through building hardening, which will allow lesser standoff distances. Even with the latter, the minimum standoff distances cannot be encroached upon. These setbacks will establish the maximum buildable area. All standards in Appendix B of UFC 4-010-01 must be followed and as many of the recommendations in Appendix C that can reasonably be accommodated should be included. The facility requirements listed in these specifications assume that the minimum standoff distances can be met, permitting conventional construction. Lesser standoff distances (with specific minimums) are not desired, however can be provided, but will require structural hardening for the building. See Project Specific Requirements for project specific siting constraints. The following list highlights the major points but the detailed requirements as presented in Appendix B of UFC 4-010-01 must be followed.

- (a) Standoff distance from roads, parking and installation perimeter; and/or structural blast mitigation
- (b) Blast resistant windows and skylights, including glazing, frames, anchors, and supports
- (c) Progressive collapse resistance for all facilities 3 stories or higher. Unless determined otherwise by the Installation and noted in paragraphs 3 or 6, the building shall be considered to have areas of uncontrolled public access when designing for progressive collapse.
- (d) Mass notification system (shall also conform to UFC 4-021-01, Mass Notification Systems)
- (e) For facilities with mailrooms (see paragraph 3 for applicability) – mailrooms have separate HVAC systems and are sealed from rest of building

## **6.0 PROJECT SPECIFIC REQUIREMENTS FORT SILL, OK**

### **6.1. GENERAL**

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

### **6.2. APPROVED DEVIATIONS**

The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project.

6.2.1. Foundations: Due to expansive soil conditions at Ft. Sill, slabs on grade are not permitted. See paragraph 6.6.1.3.

6.2.2. Pressure piping. No Type M for underground pressure pipe will be allowed. See paragraph 6.8.2.

### **6.3. SITE PLANNING AND DESIGN**

#### **6.3.1. General:**

6.3.1.1. The Government will designate approximate building site locations and related site features within the drawing included in Appendix J. Since finish grades are not specifically established for specific site responsibility areas, establish finish grades.

6.3.1.1. Site Design. The Contractor is responsible for the shape of the footprint and the building orientation of the proposed facility or facilities on the designated parcel of land (designated as building envelope on the drawings) with respect to adjacent and future facilities shown on the drawings. Locate the facility on the respective parcel of land. The Government must approve any proposed changes from the layout identified in the RFP. Connect all utilities from the building to the service connection point, with the exception of natural gas. Coordinate between the drawings and other contractors relating to site, facility design and functionality and utility connections and outages. Coordinate specific utility outages a minimum of 48 hours in advance through the CO.

6.3.1.2. Upon finalizing the building footprint, provide proposed building footprint, site orientation and requests for deviations from the drawings for Government concurrence and coordination, as applicable, with other product lines. The Government will enforce coordination of proposed buildings and finalize the placement of the buildings within the drawings boundaries and finalize associated site grading around the proposed facilities; however, the Contractor shall be responsible for coordination efforts with work by others on adjacent sites. The Government may modify desired building placement within the building envelope, if deemed necessary. The Government will provide survey control benchmarks and monuments within the specific site area. Set finish floor as indicated in the RFP Drawings and at least a minimum of 8-inches higher than predominant exterior grade. Slope exterior finish grade down and away from each building at a minimum of 5% slope for the first 10 feet. Under no circumstances shall any slope exceed 20% unless retaining structures are not feasible.

#### **6.3.1.3. Privately Owned Vehicle (POV) Parking.**

See Appendix EE - Infrastructure Drawings.

#### **6.3.1.4. Additional Information**

The Burns & McDonnell infrastructure drawings are provided as "for information only" reference. The selected D/B contractor will be responsible for design and construction of all building and site work depicted in Appendices EE and FF. The D/B contractor is responsible for validating that the information provided in the Burns & McDonnell design works with their proposed building design/layout and the D/B contractor will be the designer of record responsible for submittal of a complete design package and all as-built drawings. All site amenities required by the request for proposal or required by the contractor's proposed design are the responsibility of the D/B contractor and thus, they will be responsible for determining the location and providing the design.

Any changes to site plan layout that require the relocation of utilities shown on the Burns & McDonnell drawings,

additional trenching, or revisions to the building footprint shown on the plans will require the Ft. Sill Environmental Quality Division to restart the Section 106 consultation, which requires a minimum of 150 days. If additional time is required based on a proposed/accepted design, then a modification will be issued to extend the contract duration for any associated delays in construction.

#### 6.3.2. Site Structures and Amenities

Provide one dumpster pad and enclosure per facility. Locate dumpster enclosure per UFC 4-010-01. Dumpster screening, if required, shall be compatible with the building(s) they serve and shall incorporate the concepts of the architectural theme defined in Appendix F. Locate, design and construct dumpster enclosure(s) as directed within the drawings.

See Appendix EE - Infrastructure Drawings.

#### 6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems. Storm drainage system design is shown within the drawings at Appendix J. Design any additional storm drain system required by the project. If the Contractor chooses to connect roof drain leaders to the storm water systems, coordinate the location and size for connection of roof drain leaders to the site storm water system with other contractors, as applicable, through the Contracting Officer prior to finalizing building design a minimum of 45 days prior to beginning building construction. The Contractor is responsible for the Storm Water Pollution Prevention Plan (SWPPP) of the entire construction site. Submit site specific SWPPP in accordance with requirements contained in Section 01 57 23 TEMPORARY STORM WATER POLLUTION CONTROL. Make any piping connection from the building to the connection point.

Include all information in the Storm Water Pollution Prevention Plan (SWPPP) required by the Oklahoma Department of Environmental Quality (ODEQ) General Permit OKR10 for storm water discharges from construction activities within the State of Oklahoma. A copy of the OKR10 permit may be found at the following web page: [http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10\\_final\\_permit\\_13\\_sep\\_2007](http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10_final_permit_13_sep_2007)

6.3.3.2. Erosion and Sediment Control. The Fort Sill Environmental Division of Public Works oversees the Stormwater Sediment and Erosion Control Management Plan for the Post.

#### 6.3.3.3. Vehicular Circulation.

(a) Design and construct site pavement to provide access for Ft Sill's fire trucks. The turning radius of the ladder truck is 75-feet 6-inches and weight is 30 tons.

(b) See Appendix EE - Infrastructure Drawings.

#### 6.4. SITE ENGINEERING

6.4.1. Existing Topographical Conditions. The Government has provided a three dimensional digital topographic and utility survey. Bring any discrepancies which are found in the Government furnished survey to the immediate attention of the Government for clarification. Drawings showing existing conditions are included within Appendix J.

A three dimensional digital topographic and utility survey is provided in Appendix EE. Bring any discrepancies which are found in the Government furnished survey to the immediate attention of the Government for clarification.

6.4.2. Existing Geotechnical conditions: See Appendix A for a preliminary geotechnical report.

The following supersedes the 1<sup>st</sup> sentence of paragraph 5.2.2.1: A report that contains raw data for the project site is contained in Appendix A. Borings, a boring location map, and the raw data on the subsurface conditions are included in the referenced appendix.

6.4.2.1. The following supersedes the 4<sup>th</sup> sentence of paragraph 5.2.2.1: Additional subsurface investigations and laboratory analysis are required to better characterize the site and develop the final design. Perform the investigation and analysis subsequent to award under the direction of a licensed geotechnical engineer.

6.4.3. Fire Flow Tests See Appendix D for results of fire flow tests to use for basis of design for fire flow and domestic water supply requirements.

Currently there are no connection points or fire hydrants available in this area. The Hydrant Flow Data provided should be considered estimated flow only.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.5. Traffic Signage and Pavement Markings

Provide all pedestrian and vehicle signage in accordance with Appendices H and EE.

6.4.6. Base Utility Information

6.4.6.1. Utilities: The Installation's DPW supervises infrastructure and utilities. Most utilities are privatized. Points of contact for utilities and rates are shown in Section 00 73 00 SPECIAL CONTRACT REQUIREMENTS or 00 73 10 TASK ORDER SUPPLEMENTAL CONTRACT REQUIREMENTS, as applicable to this contract or task order. Existing utility services such as potable water, sanitary sewer, electric, natural gas, and COMM are not located near the site. Closest locations for tie-ins are shown on drawings in Appendix J. Coordinate and plan utilities with the A/E Integrator through the Contracting Officer. The site plan contained in Appendix J provides utility main routing and general orientation for points of connection for each facility. Prior to final design, Verify the locations and sizes of utility services with the A/E Integrator.

(a) Storm Drainage System tie-in points are shown in the drawings at Appendix J. Tie into these systems as appropriate.

(b) Natural Gas distribution lines are shown on drawings at Appendix J. Coordinate point of connection to the facility with the service provider, Oklahoma Natural Gas (ONG), through the CO. The private utility contractor will run Natural gas service, including meter and regulator, to the face of the building.. Connect to the meter and all piping past the meter outlet. The D/B Contractor is not responsible for costs incurred for services provided by the service provider (ONG). Coordinate and provide gas flow and pressure (if different from the standard pressure) requirements with ONG. Coordinate the location of the facility gas connection with the A/E Integrator and ONG and follow ONG's written and diagrammed location requirements, see Appendix . Design and construct the required building service lines and modifications to any distribution lines in accordance with the requirements of ONG. Also see paragraph entitled "Metering Utilities" in this section.

(c) Water mains are shown on the drawings at Appendix J. Coordinate points of connection through the A/E Integrator with the service provider, American Water Enterprises (AWE). The Infrastructure Contractor will provide the potable water service between the main line to the 5-foot line of the building. Provide potable water service from the 5-foot line to the facility and within the building, through a backflow preventer (generally located in the mechanical room). Coordinate with the service provider, AWE through the CO. The Government will provide primary or main water pipe distribution, including the water meter and vault.. Design and construct water service lines from the 5-foot line to the building to meet the utility provider's installation details and specifications. The Government will provide the Post Indicator Valve (PIV) and any bollards required for protection and route the fire water line (separate from the domestic supply) to 5 feet from the building. See Appendix for AWE requirements.

(d) Sanitary Sewer: The Infrastructure Contractor will design and construct the sanitary sewer service line between the sanitary sewer main to 5 feet from the building, including cleanout or manhole. Sanitary sewer mains are shown on the drawings in Appendix J. Coordinate points of connection through the CO with the service provider (AWE).

(e) Electricity: Others will provide the electrical distribution system , including the primary feed from the distribution line to the pad-mounted transformer. See Appendix J for drawings. Complete the design and construct the work from the pad-mounted transformer. Provide underground secondary service from the pad-mounted transformer to the building electrical equipment room. Power for buildings will be provided from pad-mounted distribution transformers. Locate electric meters in service entrance electrical equipment/switchgear located in the main electrical room. Coordinate with the Infrastructure Contractor for installation of the primary underground feeder to the service entrance transformer.

- (f) Communications. See Appendix J for Communications service plans and capacities. Coordinate through the CO with the Fort Sill Directorate of Information Management (DOIM). Determine requirements and capacity for each facility and verify with the DOIM, through the CO, that the infrastructure supports the requirements and capacity of the facility..
- (g) Cable TV is privatized. The privatized utility (Sudden Link) will provide service to the building. Provide outlet locations in the building(s), including backbox, mud ring and raceway and vertical/horizontal coaxial cable wire management including, but not limited to, labeling and identification. Provide faceplates for coaxial terminator to be installed by Sudden Link. Sudden Link will terminate all Contractor provided coaxial CATV cables. Provide a pre-wired CATV system throughout designated spaces. CATV system includes, but is not limited to, cables, conduits, pull boxes and CATV jacks. Route all CATV signal conduits and cables back to the communications room or other designated room/closet.
- (h) Others will provide telephone system distribution design. Local Telephone Service tie-in points are shown on the drawings at Appendix J. The Infrastructure Contractor will provide telephone conduit duct bank from the primary distribution manhole to 5 feet outside the building. Design and install the telephone conduit duct bank from the 5 foot line of the building to the communications room. Share the telephone duct bank with the communication duct bank. DOIM will provide telephone cabling.

#### 6.4.6.1.1. Metering Utilities.

- (a) Provide water meters Prepare meters for EMCS connection The gas utility provider will provide and install gas meters.. Provide connection from the gas and water meters to the EMCS system.
- (b) Provide an electronic meter with equivalent capabilities to a Square D Power Logic Monitor Series 4000. Electric meter shall communicate with the EMCS. Connect to the EMCS.. Locate electric meters in the service entrance electrical equipment/switchgear located in the main electrical room.

#### 6.4.7. Cut and Fill

#### 6.4.8. Borrow Material

Borrow is not available on base.

#### 6.4.9. Haul Routes and Staging Areas

##### 6.4.9.1. Use the Haul Route(s) shown in Appendix J.

6.4.9.2. The Contractor will be allotted an area as shown in the attached Access and Haul Route Plan for the placement of a construction trailer complex, if required, and storage . D/B Contractor shall be responsible for the site preparation, fencing, access drives and maintenance of his compound at all times.

6.4.9.3. For proposal purposes, the D/B Contractor may assume utilities will be provided during construction at the project site.

#### 6.4.10. Clearing and Grubbing:

Required.

#### 6.4.11. Landscaping:

Coordinate landscaping scheme with the Acceptable Plant List (Appendix I). Slopes shall not exceed 10:1 unless otherwise noted or shown on the rough grading plan as shown in Appendix J. Use a drip system for all irrigation for plantings. Rip-rap isn't permitted for erosion control. Use stone or brick for edging for planting beds. Steel or plastic edging isn't permitted. Plant trees such that the grade around the tree is recessed 2-inches. Place mulch up to grade. Do not berm around trees. Make minimal use of Pine trees and evergreens. Coordinate landscaping scheme with the Contracting Officer and the ADP.

### 6.5. ARCHITECTURE

6.5.1. General: To the maximum extent possible within the contract cost limitation, the buildings shall conform to the look and feel of the architectural style and shall use the same colors as adjacent facilities as expressed herein. The Government will evaluate the extent to which the proposal is compatible with the architectural theme expressed in the RFP during the contract or task order competition. The first priority in order of importance is that the design provides comparable building mass, size, height, and configuration compared to the architectural theme expressed herein. The second priority is that design is providing compatible exterior skin appearance based upon façade, architectural character (period or style), exterior detailing, matching nearby and installation material/color pallets, as described herein.

#### 6.5.2. Design

6.5.2.1. Appendix F is provided "For Information Only", to establish the desired site and architectural themes for the area. Appendix F identifies the desired project look and feel based on Fort Sill's Installation Architectural Theme from existing and proposed adjacent building forms; i.e. building exterior skin, roof lines, delineation of entrances, proportions of fenestration in relation to elevations, shade and shadow effects, materials, textures, exterior color schemes, and organizational layout.

6.5.2.2. The design should address Fort Sill's identified preferences. Implement these preferences considering the following:

- (c) Achievable within the Construction Contract Cost Limitation (CCL)
- (d) Meets Milestones within Maximum Performance Duration.
- (e) Achieves Full Scope identified in this Solicitation
- (f) Best Life-Cycle Cost Design
- (g) Meets the Specified Sustainable Design and LEED requirements
- (h) Complies with Energy Conservation Requirements Specified in this RFP.

6.5.2.3. Priority #1. Visual Compatibility: Facility Massing (Size, Height, Spacing, Architectural Theme, etc.) Exterior Aesthetic Considerations: The buildings massing, exterior functional aesthetics, and character shall create a comprehensive and harmonious blend of design features that are sympathetic to the style and context of the Installation. The Installation's intent for this area is:

shown in Appendix F.

The building height shall not exceed 36-feet.

6.5.2.4. Priority #2. Architectural Compatibility: Exterior Design Elements (Materials, Style, Construction Details, etc.) Roofs, Exterior Skin, and Windows & Door Fenestrations should promote a visually appealing compatibility with the desired character while not sacrificing the integrity and technical competency of building systems.

6.5.2.5. See Appendix F for exterior colors that apply to Architectural character at Fort Sill. The manufacturers and materials referenced are intended to establish color only, and are not intended to limit manufacturers and material selections.

6.5.2.6. Additional architectural requirements:

- (a) Install fall protection anchor points on all roofs with a slope greater than 2:12
- (b) **Installation Preference No. 1.** Provide standing seam metal roofing with either a 20-year comprehensive weather-tight warranty or an included maintenance contract for the period of 20 years and snow/ice guards. Provide snow/ice guards that are a standard product of the roofing manufacturer and install as recommended by the roofing manufacturer.
- (c) Low slope roof systems are only allowed where required in other sections of the RFP documents. Minimum roof slope for low slope roof systems is ¼ inch per foot (2%) and 3 inches per foot (3:12) for all other roof systems. Avoid complex valleys, flashing and venting conditions, where possible.



- (d) **Installation Preference No. 2.** Provide brick and/or split face CMU to be incorporated in the exterior walls. Any EIFS provided shall be high impact resistance rated to a distance of 7-feet vertically from finish grade in accordance with applicable criteria. EIFS shall incorporate a means to drain moisture to the exterior.
- (e) **Installation Preference No. 3.** Eliminate the use of roof-top units (RTUs), clerestories, and minimize all other roof penetrations.
- (f) Provide for attenuation of external noise sources such as airfields in accordance with applicable criteria for exterior walls and roof/ceiling assemblies, doors, windows and interior partitions.
- (g) Unless, otherwise specified in paragraph 3, do not exceed levels recommended by ASHRAE Handbook Criteria for sound conditions (and levels) for interior spaces due to the operation of mechanical and electrical systems and devices.
- (h) **Trim and Flashing.** All exterior metals including gutters, downspouts and fascias shall be factory pre-finished metal.
- (i) **Bird Habitat Mitigation:** Provide a means to eliminate the congregating and/or nesting of birds at, on and in the facility. Direct special attention to pedestrian entrances and control of such nuisance.
- (j) **Exterior Doors and Frames:**
- (1) **Main Entrance Doors:** Aluminum storefront doors and frames with Architectural Class 1 anodized finish, fully glazed, with medium or wide stile are encouraged for entry into lobbies or corridors. Storefront systems shall comply with wind load requirements of applicable codes and UFC 4-010-01 requirements. Framing systems shall have thermal-break design. Color shall conform to Appendix F.
- (2) **Side Entrance Doors:** Exterior doors and frames opening to corridors or lobbies shall be insulated hollow metal and comply with ANSI A250.8/SDI 100. Door and frame installation shall comply with applicable codes and UFC 4-010-01 requirements. Color shall conform to Appendix F.
- (3) **Exterior Non-entrance Doors:** Exterior doors and frames opening to spaces other than corridors or lobbies shall be insulated hollow metal and comply with ANSI A250.8/SDI 100. Door and frame installation shall comply with applicable codes and UFC 4-010-01 requirements. Color shall conform to Appendix F.
- (k) **Finish Hardware**
- (1) All hardware in the facility shall be consistent and shall conform to ANSI/BMHA standards for Grade 1. Coordinate all requirements for hardware keying with the CO. Hardware finishes shall conform to ANSI/BHMA A156.18. Provide ANSI 626 (Satin Chromium plated on Brass or Bronze) or 630 (Stainless Steel). Install deadbolt locks on mechanical and electrical rooms keyed to the DPW keying system. Coordinate door hardware and security requirements with the functional requirements, the Room-by-Room Criteria and the electrical security/fire alarm system requirements of this document. Provide bored locks per BHMA A156.2. Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors. Provide door closers for all exterior doors, all doors opening to corridors and as required by codes. The Main entrance door is considered a high traffic door. Provide a high quality door closing mechanism complying with BHMA A 156.4 with adequate strength to ensure safe and easy operation in a high-wind environment.
- (2) **Programmable Electronic Key Card Access Systems:** Even though programmable electronic key card access may be required elsewhere in the contract – do not provide such systems..
- (3) **Keying for Facilities:** Key all doors individually, even if the doors lead to the same room. The mechanical, electrical, and communication rooms may be keyed alike, but the Installation encourages that they be keyed to the DCF-1. The cores for the mechanical electrical and communications rooms, if not keyed to the DCF-1, shall have a cylinder that is capable of receiving a Best Lock core. Provide four (4) keys for each lock. Provide master keys.
- (l) **NOT USED**
- (m) **Exterior Windows:** Provide operable windows with locks and insect screens removable from the inside.
- (n) **Thermal Insulation:** Do not install Insulation directly on top of suspended panel ceilings.
- (o) **Exterior Louvers:** Provide exterior louvers designed to exclude wind-driven rain, with bird screens, and made to withstand wind loads in accordance with the applicable codes. Provide wall louvers with the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511.



(p) Exterior Paint Systems: Provide Exterior Paint Systems in accordance with the recommendations of the Master Painters Institute (MPI) for the substrate to be painted and the environmental conditions existing at the project site. Provide a minimum one prime coat and two finish coats for exterior surfaces (surfaces except factory pre-finished material). For exterior applications, provide an MPI Gloss Level 5 finish (semi-gloss) unless otherwise specified. Apply all paints in accordance with the manufacturer's instructions.

See Section 01 10 00 Paragraph 3.0

#### 6.5.3. Programmable Electronic Key Card Access Systems:

Programmable Electronic Key Card Access System is not applicable to this facility type.

#### 6.5.4. INTERIOR DESIGN

##### 6.5.4.1. Interior building signage requirements:

Provide each occupied facility with an appropriately sized room that has been "hardened" to resist the forces of tornadoes which are prevalent in Oklahoma. Room shall be provided in accordance with ICC-500 and FEMA 361.

##### 6.5.4.1 Pallet Rack Storage System - Government Furnished, Government Installed Equipment

The Pallet Rack Storage System is a GFGL item. Provide a minimum of 3,190 pallet spaces (including floor and top shelf locations). Assume that a 5,000 pound capacity, electric, pneumatic tire, conventional fork lift will be used to place and retrieve pallets. Determine the correct aisle width based on a combination of planned pallet loads and the actual forklift to be procured for use with the system.

##### 6.5.4.2 Specialties and Furnishings

(a) Bulletin Boards: In addition to the requirements of Section 01 10 00 Paragraph 3.0., the following requirements shall also apply. Provide bulletin boards consisting of a tack board, aluminum tabular frame, and sliding aluminum framed glazed doors with a permanent header panel and a general title, such as "Notices" or "Information", and a 1/4-inch cork pinning surface glued to 1/4-inch thick plywood or hardboard backing. Provide cork with a plastic impregnated surface and burlap backing. The cork's surface finish to be smooth and be free from air pockets, raised cork blemishes, and joint imperfections. Provide the door frame with a removable glazing bead applied on the inside. Glazing to be 1/4-inch polished laminated glass. Each bulletin board door shall be complete with hardware including key operated lock. Provide aluminum hardware with anodized finish matching the frame. Header panel to be white letters on standard black background; cork panel - medium gray. Bulletin board dimensions to be 4 feet by 6 feet. Heading message shall be upper and lower case Helvetica medium, 2-inch capital letter height, centered. Secure frame to the wall by means of concealed screws or bolt hangers.

(b) Projection Screens: Provide projection screens that are ceiling recessed mounted and manual. Screens shall be flame retardant, mildew resistant and white matte with black masking borders. Bottom of screen fabric to be weighted with metal rod. Roller to be a rigid metal at least 3 inches in diameter mounted on sound absorbing supports. Ceiling recessed case to be extruded aluminum. Screens shall be UL listed. Projection screen viewing area shall be minimum 90 inches high x 160 inches wide. Furnish and install concealed electrical wiring, connections and accessories necessary for projection screen operation. Provide one ceiling recessed mounted projection screen each in the QUEING/ORIENTATION HALL and the SHAKE DOWN HALL.

(c) Projector Mount: Furnish and install a low profile ceiling mounted projector mount system. PROJECTOR NOT INCLUDED IN CONTRACT. Ceiling mount shall consist of a steel ball joint and Universal Projector Bracket. Mount shall project a maximum 6 inches below finished ceiling height and

shall securely attach to ceiling and structure above with steel mounting plate. Provide mounting hardware appropriate to ceiling conditions. Steel ball joint attaches to the Universal Projector Bracket with twist-lock engagement. Mount shall provide up to 30° roll or pitch adjustment and 360° yaw adjustment at ball joint. Two setscrews lock ball joint in position. Silver finish. Maximum load to be 26 lbs. Furnish and install concealed electrical wiring, connections and accessories necessary for projector operation. Provide one low profile ceiling mounted projector mount system each in the QUEING/ORIENTATION HALL and the SHAKE DOWN HALL.

Fully integrate interior signage as a design element with the architecture and interior design. Provide modular signage for general office areas to accommodate personnel changes or room function changes. Use International symbols to the maximum extent possible. Locate emergency/fire evacuation plans at key areas to ensure fire safety. Coordinate signage plaque colors with the interior color scheme. Provide rooms signs for electrical or mechanical spaces. Provide room control sign for conference room(s).

#### 6.5.4.2. Interior Design Considerations:

Provide maximum use of day lighting and operable windows within the constraints of the contract requirements. Provide interior surfaces that are easy to clean and light in color. Plan the interior spaces to allow maximum flexibility for future modifications.

- (a) Interior Partitions and Walls. Non-combustible construction is encouraged even where combustible materials are allowed by code.
- (b) Provide each occupied facility with an appropriately sized room that has been "hardened" to resist the forces of tornadoes which are prevalent in Oklahoma. Provide room in accordance with ICC-500 and FEMA 361.
- (c) Interior Glass and Glazing: Coordinate the arrangement of fenestrations with the proposed furniture layout.
- (c) Where moisture or moisture infiltration from the wall cavity cannot be eliminated or sufficiently reduced, consider the use of wall coverings with higher permeability ratings. Don't use wall coverings that do not breathe, such as vinyl wall coverings in high humidity areas due to the tendency for mold to develop.
- (d) Floors and Ceilings: Non-combustible construction is encouraged even where combustible materials are allowed by code.
- (e) Interior Doors and Frames: Provide hollow metal doors and frames or wood doors in accordance with the standard design and requirements of the project. All door frames shall be hollow metal.
- (f) Paint: Comply with the recommendations of, the Master Painters Institute (MPI) for the substrate to be painted and the interior environmental conditions existing at the project site. Paint a minimum of one (1) prime coat and two (2) finish coats for interior surfaces, except factory pre-finished material or interior surfaces receiving other finishes. In wet areas, provide an MPI Gloss Level 5 (semi-gloss) finish. Apply all paints in accordance with manufacturer's instructions.
- (g) Gypsum Board: Comply with ASTM C 36. Minimum panel thickness shall be 5/8-inch. Provide moisture resistant panels (glass-mat panels are encouraged) at locations subject to moisture.

#### 6.5.4.3. Specialties and Furnishings

- (a) Window Treatments: Provide horizontal mini-blinds or vertical blinds at all exterior glazed areas, unless otherwise noted.
- (b) Bulletin Boards: Provide bulletin boards consisting of a tack board, aluminum tabular frame, and sliding aluminum framed glazed doors with a permanent header panel and a general title, such as "Notices" or "Information", and a 1/4-inch cork pinning surface glued to 1/4-inch thick plywood or hardboard backing. Provide cork with a plastic impregnated surface and burlap backing. The cork's surface finish to be smooth and be free from air pockets, raised cork blemishes, and joint imperfections. Provide the door frame with a removable glazing bead applied on the inside. Glazing to be 1/4-inch polished laminated glass. Each bulletin board door shall be complete with hardware including key operated lock. Provide aluminum hardware with anodized finish matching the frame. Header panel to be white letters on standard black background; cork panel - medium gray. Bulletin board dimensions to be 4 feet by 6 feet. Heading message shall be upper and lower case Helvetica medium, 2-inch capital letter height, centered. Secure frame to the wall by means of concealed screws or bolt hangers.
- (c) Projection Screens: Provide projection screens that are ceiling recessed mounted and manual. Screens shall be flame retardant, mildew resistant and white matte with black masking borders. Bottom of screen fabric to

be weighted with metal rod. Roller to be a rigid metal at least 3 inches in diameter mounted on sound absorbing supports. Ceiling recessed case to be extruded aluminum. Screens shall be UL listed. Projection screen viewing area shall be minimum 7'-3" high x 9'-8" wide. Provide one ceiling recessed mounted projection screen in each conference area.

(d) Projector Mount: Furnish and install a low profile ceiling mounted projector mount system. PROJECTOR NOT INCLUDED IN CONTRACT. Ceiling mount shall consist of a steel ball joint and Universal Projector Bracket. Mount shall project a maximum 6 inches below finished ceiling height and shall securely attach to ceiling and structure above with steel mounting plate. Provide mounting hardware appropriate to ceiling conditions. Steel ball joint attaches to the Universal Projector Bracket with twist-lock engagement. Mount shall provide up to 30° roll or pitch adjustment and 360° yaw adjustment at ball joint. Two setscrews lock ball joint in position. Silver finish. Maximum load to be 26 lbs. Furnish and install concealed electrical wiring, connections and accessories necessary for projector operation. Provide one low profile ceiling mounted projector mount system in each conference area.

(e) Corner Guards. Provide surface-mounted, high-impact integral color rigid vinyl corner guards at all outside corners of gypsum board walls.

(f) Chair Rail. Install chair rails in areas prone to hi-impact use, such as corridors, classrooms, conference rooms, etc.

(g) Toilet Accessories: All toilet accessories shall be Type 304 stainless steel with satin finish.

## 6.6. STRUCTURAL DESIGN

### 6.6.1. Site Specific Loading Requirements:

6.6.1.1. Use basic wind speed of 90 mph 3-second-gust, in miles per hour, for wind loads.

6.6.1.2. Use ground snow load of 10 psf.

6.6.1.3. Use frost penetration of 14 inches.

6.6.1.4. Use the following seismic acceleration parameters for mapped Maximum Considered Earthquake spectral response at short periods and at 1-second period, respectively: Ss: 38 (%g) and S1: 2 (%g).

6.6.2. Equipment Pads: Elevate floor or on-grade mounted equipment on minimum 4 inch thick concrete pads to prevent accumulation of water and metal corrosion.

### 6.6.3. Foundation

6.6.3.1. Due to soil conditions at Ft. Sill, the use of pier and supported grade beam foundation with structurally supported slab, conventional rib mat slabs or thickened structural slabs is required for this project. Slabs on grade or floating slabs are not permitted.

6.6.3.2. Perform controlled expansion consolidation tests on undisturbed samples collected from the overburden material to assess potential settlement and/or heave for piers and edge lift/center lift conditions for ribbed mat slabs and thickened slabs in accordance with ASTM D 4546, Method C, latest edition. Heave predictions using the Potential Vertical Rise (PVR) method or swell pressure predicted from free swell test are not allowed.

6.6.3.3. Assume a minimum 15-foot active zone measured from top of existing ground for uplift and heave calculations.

6.6.3.4. Provide foundation systems for permanent facilities capable of supporting the typical loadings specified elsewhere in this document that are capable of resisting the soil movement and chemical characteristics of the soils present for the design life of the facility. Systems proposed are to have been used successfully at the Installation for a time period equal to the design life of the proposed facility or submit documentation from an acceptable independent certifying entity certifying that a proposed alternate system has been used successfully for a period of time equal to the design life of the proposed facility on a minimum of 10 facilities where the soil movement and chemical characteristics are the same as at the Installation.

6.6.3.5. **Site Features – Retaining Walls/Bridges/etc.** Design site features with maximum 2 in 1 slope (same as the earth cover). Design site features to drain properly and tie into the drainage collector system.

#### 6.7. THERMAL PERFORMANCE

There are no additional requirements other than those previously stated/referenced.

#### 6.8. PLUMBING

6.8.1. **Piping Materials:** Provide Piping materials per applicable criteria but pipe materials may be restricted based on specific conditions at a particular site. Type M copper is not allowed. Type L above ground pressure piping and copper Type K for underground pressure pipe are preferred. Non-plastic drainage, waste and venting (DWV) plumbing materials are preferred, however, PVC or ABS waste and vent pipe is acceptable.

6.8.2. **Cross Connection Control:** Follow local site specific requirements for cross connection control / backflow prevention. Provide an inlet water backflow prevention device for each facility. Protect potable water systems from contamination by hydronic water and other industrial and mechanical systems via a reduced pressure zone backflow preventer.

6.8.3. **Natural Gas Supply:** Normally use the standard gas pressure from utility provider's building regulator of 5.3 ounces. If higher pressures are needed, coordinate those requirements with the utility provider. Provide the utility provider with required flow rate and expected gas usage diversity so the utility provider may provide the appropriate metering and regulation equipment. Report no diversity, that is, all loads are firing at the same time in the facility.

6.8.4. **Gas Regulator Venting:** Vent all gas regulators in building to the outside.

6.8.5. **Domestic Water Heating:** The Installation encourage the use of point-of-use instantaneous domestic hot water heaters for small hot water demand areas such as small restrooms (small is considered to be two lavatories or less) and gas-fired hot water storage heaters for larger demand areas such as larger gang restrooms and restrooms with showers.

6.8.6. **Exterior Water Piping Freeze Protection:** Design seasonally utilized (not used in winter) water supply piping for complete drain down. Provide an interior or below grade isolation valve. Insulate exposed water piping that is utilized year round, heat traced and protected with pipe jacketing to ensure that the piping will not freeze.

#### 6.8.7. Fixture Faucet Mixing Valves:

(a) For administrative and classroom facilities, the automatic flush and water valves, with long-life batteries and backup manual flush buttons, for water closets, urinals and lavatories perform best.

(b) Provide automatic mixing type with anti-scald temperature control shower valves (pressure balancing/compensating type). Additionally, valves shall not have any internal or exterior plastic parts.

6.8.8. **Wall Hydrants.** Provide non-freeze wall hydrants on all building faces at no more than 100-foot intervals.

#### 6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. **Exterior Lighting.** Design and install exterior lighting within the construction limits. Exterior site and area lighting shall be pulse-start metal-halide (PSMH) or induction type, except compact fluorescent lighting is acceptable for walkway lighting where suitable for the climatic conditions. Exterior lighting includes parking areas, hardstands, roadways and walkways. Photo control devices for exterior lighting shall have adjustable operation range of approximately 0.5 to 5.0 foot candles. Provide protective lighting systems at the perimeter fence where required by the specific project to deter trespassers and to make them visible to guards. Use 90 degree cut off lighting facing any runway.

6.9.2. **Exterior Electrical:** Design and extend the electrical service underground from the pad-mounted transformer to building service equipment/main electrical switchgear.. Coordinate all electric work and interruptions through the CO and Ft Sill DPW. The existing distribution system is a 13,200Y/7,620 V three-phase, four-wire multi-ground system. Duct lines (600-volt) shall be direct buried thick wall type; concrete encased in vehicular

traffic areas. Provide two spare conduits from the transformer to the building service equipment/main electrical switchgear..

**6.9.3. Exterior Communications:** Communications service to the buildings shall be underground six-way 4-inch conduit duct banks. Design and install the duct bank from 5-foot outside the building to the building's communications room. In each duct bank; dedicate one (1) 4-inch conduit to copper cables; dedicate one (1) 4-inch conduit to CATV coaxial cable and dedicate one (1) 4-inch conduit with two (2) 3-way fiber mesh to fiber optic cable. The other three (3) 4-inch conduits are spare. Others will provide duct bank, fiber optic and copper cabling from the manhole(s) to within 5-foot of the building at a location closest to the communications room under separate contract. Others will splice and complete the termination of the outside plant cables in the manhole and communications room. Securely fasten all entrance conduits to the building so they can withstand a typical placing operation. Keep area around the entrance conduit free of any construction, storage and mechanical apparatus.

## 6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.10.1. Power system study shall consist of fault analysis and coordination study.

**6.10.2. Lightning Protection and Grounding:** Provide lightning protection shall be provided based on NFPA 780 (2004) Annex L Lightning Risk Assessment of the facility. Provide grounding, bonding, shielding for all facilities. Provide grounding straps and connect to the building grounding system. Provide grounding points in vehicle and equipment parking areas on 20 foot centers (maximum) and coordinated with the power and data board units. Provide ground strap on walls, and two (2) grounding points on each functional bay floor. Provide a bonding grounding in oil storage room.

**6.10.3. Closed Circuit TV (CCTV):** Install a conduit system to support CCTV throughout designated spaces. The conduit system includes but is not limited to conduits, pull boxes and pull wires. Route all conduits for CCTV signals back to the telecommunications room or the designated monitoring room.

**6.10.4. Telephone and Local Area Network (LAN):** Provide complete riser diagrams and equipment locations on the drawings. Connect the facility to the installation Campus Area Network (CAN) System and telephone system in accordance with the I3A (and SIPRNET guide, where applicable in paragraph 3). Communications systems resources will be allocated in accordance with the I3A regarding outlet densities based upon the functionality of the facility's (ies') various component floor spaces. Connect all standard MILCON outlets from the telecommunications room equipment communication patch panels with 2 pair, TIA/EIA 568-B Category 6 unshielded twisted pair (UTP) solid copper station cable. Connect all single 8-position wall outlets from the commercial rack patch panels with one pair TIA/RIA 568-B CAT 6 UTP cable. Provide a weatherproof telephone enclosure located on an exterior wall near the main entrance of each building.

**6.10.5. Communication Testing.** Provide material and documentation for communication testing. Provide complete end-to-end certification of all wire/cable installed in accordance with the TIA/EIA 568 Standards. Provide 30 days notification of testing. Testing includes but is not limited to:

- (a) A submitted and Government approved test plan.
- (b) Test of all installation ground bus bars, wiring and ground grids.
- (c) Furnishing test results within 7 days of testing performance and prior to final acceptance.
- (d) Test results include, as a minimum, electrical resistance readings, continuity readings, insulation and resistance and dB loss readings. Include graphical representation of results. Include: date, time, tester, building number, room number and panel number.

**6.10.6.** Terminate all components prior to testing. There will be no acceptance of equipment and systems until the required inspections and tests have been made and submittal of the required documentation to the Government.

## 6.11. HEATING, VENTILATING, AND AIR CONDITIONING

6.11.1. General:

6.11.1.1. Integration of new facilities into the existing EMCS database and monitoring and controls software (such as the Post-wide demand limiting) will require generation of custom graphics matching the style and

complexity of the existing graphics. Integration of new facilities shall also include programming of alarm handling and demand load limiting which will require Directorate of Public Works (DPW) input for critical alarm lists and priority of building for demand load limiting. This must be done at the existing EMCS "front-end." Integration will be limited to qualified companies and personnel. Fort Sill's encourages the use of Tour Andover Controls (TAC) or their designated local representative in Oklahoma City, OK (OKC) do the integration; TAC's OKC representative is, Energy Management & Controls Synergy (EMCS), contact Mr. Jeff Houpt, 405-528-3627. Other possible integrators are: Tang & Associates, contact Mr. John Huston, 312-616-7498 or EMC Engineers, contact Mr. Carl Lundstrom, 678-254-1221. Note that TAC and EMC Engineers are the only companies currently familiar with the Fort Sill EMCS.

**6.11.2. Water Quality Analysis and Treatment:** Water quality for the Installation and surrounding area is "hard." Treatment will be required for use as make-up water in HVAC equipment. Water Quality Analysis reports are included at Appendix. . Additional water analysis data from water treatment contractor is provided below:

Chlorides: 16 ppm

Total Alkalinity: 90 – 140 ppm (Total alkalinity varies by season.)

Total Hardness: 157 ppm (CaCO<sub>3</sub>)

ph: 8.00

Silica: 3.4 ppm (SiO<sub>2</sub>)

Iron: approx. 0.017 Reactive (Leaving plant; varies with location, age of piping, etc.)

Total Dissolved Solids: 190 ppm

6.11.2.1. Coordinate with water treatment contractor to confirm water data and current water treatment methods to obtain the required quantity and types of chemicals to be initially introduced into the closed loop heating and chilled water systems. Currently, water treatment is contracted by VT Griffin to Nalco Chemical Company.

#### 6.11.3. Fuel for Heating/Cooling

6.11.3.1. **Installation Preference No. 4.** Ft. Sill's preference for heating/cooling systems is geothermal or natural gas heating with geothermal most preferred. The preferred type of geothermal system is drilled wells with closed circuit earth heat exchange pumping and piping system to gather heat from the earth for exchange to water or air for heating in the facilities.

6.11.3.2. HVAC Cooling Building Systems: Electric driven refrigeration and cooling systems are the most prevalent types at Fort Sill. Geothermal systems and other renewable or highly energy-efficient types of cooling are definitely encouraged over standard refrigeration-based equipment (DX, chilled water, etc.), where they are applicable. Fort Sill currently has several facilities (family housing, UEPH, BEQ, large office buildings, etc.) that are cooled and heated by geothermal closed-loop, drilled vertical borehole systems that are very successful. Evaporative cooling, direct and indirect evaporative building cooling systems, can be energy efficient; and state-of-the-art types proposed will be readily considered as long as site limitations such as climate, dust storms, etc. are taken into account. Do not provide the old style "swamp" direct evaporative pad or media coolers as a form of building cooling as they suffer from water mineral, dirt buildup and are maintenance intensive.

6.11.3.3. HVAC Central Cooling Plant Systems (serving more than one building or facility): Electric driven refrigeration and cooling systems are the most prevalent types at Fort Sill. Chiller plants mainly employ electric centrifugal chillers with water cooling towers. While this type of system is acceptable for maintenance and durability, Ft Sill encourages the use of other types of cooling systems, such as geothermal central plants that have been installed and are in use. Newer plants, where they are proposed or required should be of much higher efficiency than standard energy code minimum systems and are highly encouraged to employ renewable energy such as geothermal. The recommended type of geothermal cooling/heating system is drilled wells with closed circuit earth, lake, etc. heat exchange to water for cooling/heating plants.

#### 6.11.4. Mandatory Equipment Requirements:

6.11.4.1. All mechanical equipment shall automatically restart after a power outage. Provide equipment such as boiler low water boiler cut-offs and controls that can restart in a normal mode after power is restored. Protect all mechanical equipment and controls against power surges and low and high supply voltage situations.

Power loss, surges or low or high voltage shall not, in any way, effect HVAC or plumbing equipment or controls, set points, controls bindings etc.

6.11.4.2.       Boiler Size: The maximum allowable individual boiler size that can be utilized is 10 million Btu per hour (input); this is a non-negotiable and mandatory Ft Sill requirement for them to operate under their current Environmental Air Quality Permit.

6.11.4.3.       HVAC On/Off Switch. Provide an on/off switch for all HVAC systems in a central location as per UFC 4-010-01. Coordinate this requirement and switch features with local installation DPW during design.

6.11.4.4.       HVAC Controls: Provide manual button or switch allowing users to have the capability to do minimal "run longer" control. Intent is for building users to work odd shifts without requiring Installation DPW input. HVAC controls shall provide all of the monitoring and controls points as mentioned for EMCS and shall expose all of the reset, tuning, etc. parameters as required for a completely open system as discussed above for EMCS. Coordinate with the CO to obtain the building occupied/unoccupied schedule for the facility; use that schedule for building controls and EMCS.

6.11.4.5.       Chilled Water System Volume Requirements. For each chilled water system, the system must contain a minimum of 4-gallons per ton of chilling capacity, or more, if required by the manufacturer of proposed chiller. The volume calculation shall exclude the water volume of the chiller and all load heat exchange developed (coils, etc.) in the system. If the system volume does not contain the minimum volume, a chilled-water storage tank shall be designed to bring the system volume to the required minimum. The chilled-water storage tank shall be piped into the chilled water return line upstream of the chiller.

6.11.4.6.       Provide all exterior air cooled HVAC equipment with hail guards.

6.11.4.7.       Generator Equipment: Stationary emergency or electrical generator equipment shall use natural gas as a fuel source. This is required by the Installation's Environmental Permit.

6.11.5. **Installation Preference No. 3.** Ft. Sill prefers that no equipment, including HVAC, be roof mounted. However, if provided by the D/B Contractor, the D/B Contractor shall provide proper permanent ladders, roof-protecting walking surface and adequately large OSHA-approved work surfaces around each device or piece of equipment. See paragraph 6.5.2..

6.11.5.1.       Equipment Placement: When possible, place the of air handling equipment to be either within the building spaces (i.e., equipment rooms or plants, etc.) which are sound isolated, within exterior on-grade equipment yards which are enclosed with screen walls or within enclosed roof penthouses. The Installation DPW encourages designers to organize vents, stacks, grilles and placement of mechanical or electrical service fixtures into locations which do not provide visually negative design impacts. Where possible, avoid catwalks especially when up and down travel is required to service multiple equipment pieces. (Coordinate with architectural design and RFP requirement.)

6.11.6. **Fort Sill's Freeze Protection:** Provide full protection down to lowest temperature with propylene glycol (PG) solution (dowfrost HD) or a combination of a lower concentration of PG in combination with controls logic to start and run the chilled water pumps to circulate water to help avoid freezing. If any secondary protection is required or provided it shall be self regulating, industrial grade with shielded jacket heat tracing.

## 6.12. ENERGY CONSERVATION

### 6.12.1. General

Energy conservation is a prime objective and measures shall include but not limited to following:

ASHRAE 90.1 - Energy performance shall be governed by ASHRAE Standard 90.1, exceeded by 30% for each facility. The Offerors shall document in the design analysis (design after award) that the building and systems exceed the standard by the required minimum percentage utilizing hand annotated Standard 90.1 reporting forms and hour-by-hour energy analysis software (TRACE, E20-II HAP, BLAST, etc.) , required life-cycle cost equipment selection and building energy analysis.

- (a) Electronic Ballasts
- (b) Switched Light Fixtures

(c) Occupancy and photo sensors  
Solar Power for Exterior Lighting  
Variable Frequency Drives  
Timers  
High efficiency motors.  
Daylighting  
Heat recovery from exhaust  
Shower gray water heat recovery

Usage of high efficiency (equal to or greater than 90%) boilers and water heating equipment is strongly encouraged in order to save energy. Additionally, use of boilers or heating equipment that features fully ducted combustion air intake is encouraged.

6.12.2. Inclusion of Renewable Energy Features. The following renewable energy features have been determined lifecycle cost effective, are included in the project budget and shall be provided:

No additional requirements.

### 6.13. FIRE PROTECTION

6.13.1. Fire Sprinkler Service: Provide a separate fire sprinkler service connection within each building that requires fire sprinklers. Provide Knox boxes. Provide a Post Indicator Valve (PIV) and any bollards required for protection.

6.13.2. Provide fire hydrants.

6.13.3. Riser Location: Install fire risers in a dedicated space or mechanical room with external access and keying for the Fire Department.

6.13.4. Fire Sprinkler Seismic Design: Since the installation is located in a seismic zone, design fire sprinkler systems for protection of piping against damage from earthquakes per NFPA 13.

6.13.5. Fire Sprinkler Backflow Prevention: Double check valve backflow preventers are the minimum protection required for all sprinkler systems. Systems utilizing antifreeze require reduced pressure principle backflow preventers.

6.13.6. Mass Notification System (MNS)/Public Address (PA): The MNS system shall be fully functioning and shall be designed and installed to operate as both MNS and PA. The systems shall be zoned and permit zonal selection of paging by both installed microphone jacks and telephone dialup. Indicating devices shall be visual and located throughout the facility including exterior wall locations. All strobes for the MNS shall be synchronized with the fire alarm strobes in the event both are active at the same time. The MNS shall have the ability to interrupt all localized audio systems that are independent of the building-wide PA system. The Installation-wide giant voice system is an ADT MNS. Each building shall communicate with the ADT Central Control Unit via an existing radio frequency transmitter and antenna. Furnish and connect the following equipment:

(a) One (1) mass notification panel in accordance with the requirements of UFC 4-021-01 and compatible with the existing giant voice system at Fort Sill.

(b) One (1) transceiver with the ability to communicate with the Installation's big voice radio frequency (RF) equipment with the ability to transmit and receive information.

(c) Install One (1) antenna at the facility.

(d) Connect eight (8) dry contacts to the building MNS for controlling prerecorded messages and push-to-talk for audio (remainder of the eight (8) shall become spares). Connect the 600-ohm audio for audio from the central control unit to the MNS.

6.13.7. Fire Alarm Systems: Provide Class A addressable systems consisting of a fire alarm panel, an RF transceiver, initiating devices and notification devices. The Fire Alarm Control Panel shall be fully compatible with the existing Monaco system. Provide pull stations that are single-action, non-glass rod type.

6.13.7.1. **Installation Preference No. 5:** Provide the required fire alarm system with 72 hours of standby with 15 minutes of alarm in lieu of the 24 hours of standby required by code.



- 6.13.7.2. The RF transceiver shall be a Monaco BT-X (verify with Post Fire Chief) or approved equal operating on a frequency of 141.3625 MHZ. Provide transceiver communication with the Lawton, Oklahoma 911 dispatch located off Post
- 6.13.7.3. The fire alarm receiving system is a Monaco D-21 system.
- 6.13.7.4. Provide zone by zone information sent to the Fire Department receiving system. Send All tamper devices to the D-21 system as a supervisory tamper.
- 6.13.7.5. Provide all initiating devices that are connected, Class A, Style D, to signal line circuits (SLC), Style 6.
- 6.13.7.6. Provide all alarm appliances connected to notification appliance circuits (NAC), Class A, Style Z.
- 6.13.8. Furnish all software, software locks, special tools and any other proprietary equipment required to maintain, add devices to or delete devices from the system or test the fire alarm system prior to the final inspection of the system.

#### 6.14. SUSTAINABLE DESIGN

- 6.14.1. LEED Rating Tool Version. This project shall be executed using LEED-NC Version 2.2.
- 6.14.2. The minimum requirement for this project is to achieve LEED Silver level. Each non-exempt facility (building plus sitework) must achieve this level. In addition to any facilities indicated as exempt in paragraph 3, the following facilities are exempt from the minimum LEED achievement requirement: None..
- 6.14.3. Credit Validation: LEED registration, compiling of documentation at LEED OnLine and use of the LEED Letter Templates is required. Registration and payment of registration fees will be by the Government. Administration/team management of the online project will be by the Contractor. Validation of credits will be accomplished by the Government. LEED certification of the project by the Contractor is not required. The Government may choose to seek LEED certification of the project, in which case the Government will pay certification fees and coordinate with the GBCI and the Contractor will furnish audit data as requested at no additional cost.
- 6.14.4. Commissioning: See Appendix M for Owner's Project Requirements document(s).
- 6.14.5. LEED Credits Coordination. The following information is provided relative to Sustainable Sites and other credits.

#### **SS Credit 1 Site Selection:**

- Project site IS NOT considered prime farmland.
- Project site is five feet or more above 100-year flood elevation.
- Project site contains no habitat for threatened or endangered species.
- No portion of project site lies within 100 feet of any water, wetlands or areas of special concern.
- Project site WAS NOT previously used as public parkland.

#### **SS Credit 2 Development Density & Community Connectivity.**

- Project site DOES NOT meets the criteria for this credit.

#### **SS Credit 3 Brownfield Redevelopment.**

- Project site DOES NOT meets the criteria for this credit.

**SS Credit 4.1 Public Transportation Access.**

Project site DOES NOT meets the criteria for this credit.

**EA Credit 6 Green Power.**

35% of the project's electricity WILL NOT will be provided through an Installation renewable energy contract. Do not purchase Renewable Energy Credits (REC's) to earn this credit.

**MR Credit 2 Construction Waste Management.**

The Installation does not have an on-post recycling facility available for Contractor's use.

6.14.6. LEED Credit Preferences, Guidance and Resources. See Appendix L LEED Project Credit Guidance for supplemental information relating to individual credits.

6.14.7. Not Used

6.14.8. Additional Information

None.

**6.15. ENVIRONMENTAL**

6.15.1. Solid Waste Disposal/Diversion Practices:

6.15.1.1. Solid Waste Disposal/Diversion Practices shall be in accordance with Fort Sill Landfill policies and LEED requirements. No offsite disposal is permitted. Dispose of all construction material waste and debris from demolition in the Ft Sill landfill (Dodge Hill). Items that can be used to help decrease diversion rates include salvaged items (may be reused by others), scrap metal, masonry products, gravel, asphalt, concrete, rock and topsoil (earth fill is specifically excluded). There are segregated areas at the landfill for disposal of asphalt, concrete and rock. Dispose of waste fill on Post; The Contracting Officer (CO) will coordinate and approve location of disposal areas. There is no charge for using the Ft Sill Landfill. Confine construction limits to the construction site boundaries shown on the drawings within Appendix J.

6.15.1.2. Government policy applies to sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy, (1) Practice efficient waste management when sizing, cutting, and installing products and materials, (2) use all reasonable means to divert construction, and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

6.15.2. Asbestos containing materials (ACMs), lead based paint (LBP), or PCBs shall not be used in the project.

6.15.3. Air pollution restrictions applicable to this project do not allow materials to be burned on Government premises.

6.15.4. Oil Water Separators (OWS). Fort Sill requires OWS to be installed in a vault per local EQD requirements. Equip the oil water separator with a sensor/alarm panel that indicates when the separator requires service. Also include a sump pump tied to the separator for removal of rainwater from the vault.

**6.16. PERMITS**

Obtain permits from Fort Sill for each generator required for on-site electrical service. Note that generators equal to or larger than 500 hp, in use for more than 1-year require a permit from Fort Sill EDQ.

**6.17. DEMOLITION**

See Appendix EE - Infrastructure Drawings.

**6.18. ADDITIONAL FACILITIES**

No additional facilities.

End of Section 01 10 00.0001

**SECTION 01 33 00.0001  
SUBMITTAL PROCEDURES  
(DESIGN-BUILD TASK ORDERS)**

**1.0 GENERAL**

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

1.14. INFORMATION ONLY SUBMITTALS

**1.0 GENERAL**

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 33 30 apply to this task order, except as otherwise specified herein.

**1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS**

Upon completion of review of submittals requiring Government approval or concurrence, the Government will stamp and date the submittals as approved or concurred. The Government will retain zero(0) copies of the submittal and return zero(0) copy(ies) of the submittal.

**1.14. INFORMATION ONLY SUBMITTALS**

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. The Government will retain zero(0) copies of information only submittals.

End of Section 01 33 00.0001

**SECTION 01 33 16  
DESIGN AFTER AWARD**

**1.0 GENERAL INFORMATION**

1.1. INTRODUCTION

1.2. DESIGNER OF RECORD

**2.0 PRODUCTS (Not Applicable)**

**3.0 EXECUTION**

3.1. PRE-WORK ACTIVITIES & CONFERENCES

3.1.1. Design Quality Control Plan

3.1.2. Post Award Conference

3.1.3. Partnering & Project Progress Processes

3.1.4. Initial Design Conference

3.1.5. Pre-Construction Conference

3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

3.2.1. Site/Utilities

3.2.2. Interim Design Submittals

3.2.3. Over-the-Shoulder Progress Reviews

3.2.4. Final Design Submissions

3.2.5. Design Complete Submittals

3.2.6. Holiday Periods for Government Review or Actions

3.2.7. Late Submittals and Reviews

3.3. DESIGN CONFIGURATION MANAGEMENT

3.3.1. Procedures

3.3.2. Tracking Design Review Comments

3.3.3. Design and Code Checklists

3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

3.4.1. General

3.4.2. Procedures

3.4.3. Conference Documentation

3.5. INTERIM DESIGN REQUIREMENTS

3.5.1. Drawings

3.5.2. Design Analyses

3.5.3. Geotechnical Investigations and Reports

3.5.4. LEED Documentation

3.5.5. Energy Conservation

3.5.6. Specifications

3.5.7. Building Rendering

3.5.8. Interim Building Design Contents

3.6. FINAL DESIGN REVIEWS AND CONFERENCES

3.7. FINAL DESIGN REQUIREMENTS

3.7.1. Drawings

3.7.2. Design Analysis

3.7.3. Specifications

3.7.4. Submittal Register

3.7.5. Preparation of DD Form 1354 (Transfer of Real Property)

3.7.6. Acceptance and Release for Construction

3.8. DESIGN COMPLETE CONSTRUCTION DOCUMENT REQUIREMENTS

3.9. SUBMITTAL DISTRIBUTION, MEDIA AND QUANTITIES

3.9.1. Submittal Distribution and Quantities

3.9.2. Web based Design Submittals

3.9.3. Mailing of Design Submittals

3.10. AS-BUILT DOCUMENTS

**ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS**

**ATTACHMENT B FURNITURE, FIXTURES AND EQUIPMENT REQUIREMENTS**

**ATTACHMENT C TRACKING COMMENTS IN DRCHECKS**

**ATTACHMENT D SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

**ATTACHMENT E LEED SUBMITTALS**

**ATTACHMENT F BUILDING INFORMATION MODELING REQUIREMENTS**

**ATTACHMENT G DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT**



## **1.0 GENERAL INFORMATION**

### **1.1. INTRODUCTION**

1.1.1. The information contained in this section applies to the design required after award. After award, the Contractor will develop the accepted proposal into the completed design, as described herein.

1.1.2. The Contractor may elect to fast track the design and construction that is, proceed with construction of parts of the sitework and facilities prior to completion of the overall design. To facilitate fast tracking, the Contractor may elect to divide the design into no more than six (6) design packages per major facility type and no more than three (3) design packages for site and associated work. Designate how it will package the design, consistent with its overall plan for permitting (where applicable) and construction of the project. See Sections 01 33 00 SUBMITTAL PROCEDURES and 01 32 01.00 10 PROJECT SCHEDULE for requirements for identifying and scheduling the design packaging plan in the submittal register and project schedule. See also Sections 01 10 00 STATEMENT OF WORK and 01 57 20.00 10 ENVIRONMENTAL PROTECTION for any specified permit requirements. If early procurement of long-lead item construction materials or installed equipment, prior to completion of the associated design package, is necessary to facilitate the project schedule, also identify those long-lead items and how it will assure design integrity of the associated design package to meet the contract requirements (The Contract consists of the Solicitation requirements and the accepted proposal). Once the Government is satisfied that the long-lead items meet the contract requirements, the Contracting Officer will allow the Contractor to procure the items at its own risk.

1.1.3. The Contractor may proceed with the construction work included in a separate design package after the Government has reviewed the final (100%) design submission for that package, review comments have been addressed and resolved to the Government's satisfaction and the Contracting Officer (or the Administrative Contracting Officer) has agreed that the design package may be released for construction.

1.1.4. **INTEGRATED DESIGN.** To the maximum extent permitted for this project, use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for siting, energy, water, materials and indoor environmental quality and ensures incorporation of these goals. Consider all stages of the building lifecycle, including deconstruction.

### **1.2. DESIGNER OF RECORD**

Identify, for approval, the Designer of Record ("DOR") that will be responsible for each area of design. One DOR may be responsible for more than one area. Listed, Professional Registered, DOR(s) shall account for all areas of design disciplines shall be accounted for by a listed. The DOR's shall stamp, sign, and date each design drawing and other design deliverables under their responsible discipline at each design submittal stage (see contract clause Registration of Designers). If the deliverables are not ready for release for construction, identify them as "preliminary" or "not for release for construction" or by using some other appropriate designation. The DOR(s) shall also be responsible for maintaining the integrity of the design and for compliance with the contract requirements through construction and documentation of the as-built condition by coordination, review and approval of extensions of design, material, equipment and other construction submittals, review and approval or disapproval of requested deviations to the accepted design or to the contract, coordination with the Government of the above activities, and by performing other typical professional designer responsibilities.

## **2.0 PRODUCTS (Not Applicable)**

## **3.0 EXECUTION**

### **3.1. PRE-WORK ACTIVITIES & CONFERENCES**

#### **3.1.1. Design Quality Control Plan**

Submit for Government acceptance, a Design Quality Control Plan in accordance with Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL before design may proceed.

#### **3.1.2. Post Award Conference**

3.1.2.1. The government will conduct a post award contract administration conference at the project site, as soon as possible after contract award. This will be coordinated with issuance of the contract notice to proceed (NTP). The Contractor and major sub-contractor representatives shall participate. All designers need not attend this first meeting. Government representatives will include COE project delivery team members, facility users, facility command representatives, and installation representatives. The Government will provide an agenda, meeting goals, meeting place, and meeting time to participants prior to the meeting.

3.1.2.2. The post award conference shall include determination and introduction of contact persons, their authorities, contract administration requirements, discussion of expected project progress processes, and coordination of subsequent meetings for quality control (see Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL), Partnering (see below and SCR: Partnering), and the initial design conference (see below).

3.1.2.3. The government will introduce COE project delivery team members, facility users, facility command representatives, and installation representatives. The DB Contractor shall introduce major subcontractors, and other needed staff. Expectations and duties of each person shall be defined for all participants. A meeting roster shall be developed and distributed by the government with complete contact information including name, office, project role, phone, mailing and physical address, and email address.

### 3.1.3. Partnering & Project Progress Processes

3.1.3.1. The initial Partnering conference may be scheduled and conducted at any time with or following the post award conference. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. This partnership will strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership will be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs. Normally, partnering meetings will be held at or in the vicinity of the project installation.

3.1.3.2. As part of the partnering process, the Government and Contractor shall develop, establish, and agree to comprehensive design development processes including conduct of conferences, expectations of design development at conferences, fast-tracking, design acceptance, Structural Interior Design (SID)/ Furniture, Fixtures & Equipment (FF&E) design approval, project closeout, etc. The government will explain contract requirements and the DB Contractor shall review their proposed project schedule and suggest ways to streamline processes.

### 3.1.4. Initial Design Conference

The initial design conference may be scheduled and conducted at the project installation any time after the post award conference, although it is recommended that the partnering process be initiated with or before the initial design conference. Any design work conducted after award and prior to this conference should be limited to site and is discouraged for other items. All Designers of Record shall participate in the conference. The purpose of the meeting is to introduce everyone and to make sure any needs the contractor has are assigned and due dates established as well as who will get the information. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning the BIM Implementation Plan demonstration at this meeting. The DB Contractor shall conduct the initial design conference.

### 3.1.5. Pre-Construction Conference

Before starting construction activities, the Contractor and Government will jointly conduct a pre-construction administrative conference to discuss any outstanding requirements and to review local installation requirements for start of construction. It is possible there will be multiple Pre-Construction Conferences based on the content of the design packages selected by the Contractor. The Government will provide minutes of this meeting to all participants.

## 3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

The stages of design submittals described below define Government expectations with respect to process and content. The Contractor shall determine how to best plan and execute the design and review process for this project, within the parameters listed below. As a minimum, the Government expects to see at least one interim design submittal, at least one final design submittal before construction of a design package may proceed and at least one Design Complete submittal that documents the accepted design. The Contractor may sub-divide the design into separate packages for each stage of design and may proceed with construction of a package after the Government accepts the final design for that package. See discussion on waivers to submission of one or more intermediate design packages where the parties partner during the design process. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning BIM and the various stages of design submittals and over-the-shoulder progress reviews.

### 3.2.1. Site/Utilities

To facilitate fast-track design-construction activities the contractor may submit a final (100%) site and utility design as the first design submittal or it may elect to submit interim and final site and utility design submittals as explained below. Following review, resolution, and incorporation of all Government comments, and submittal of a satisfactory set of site/utility design documents, after completing all other pre-construction requirements in this contract and after the pre-construction meeting, the Government will allow the Contractor to proceed with site development activities, including demolition where applicable, within the parameters set forth in the accepted design submittal. For the first site and utility design submission, whether an interim or final, the submittal review, comment, and resolution times from this specification apply, except that the Contractor shall allow the Government a 14 calendar day review period, exclusive of mailing time. No on-site construction activities shall begin prior to written Government clearance to proceed.

### 3.2.2. Interim Design Submittals

The Contractor may submit either a single interim design for review, representing a complete package with all design disciplines, or split the interim design into smaller, individual design packages as it deems necessary for fast-track construction purposes. As required in Section 01 32 01.00 10 PROJECT SCHEDULE, the Contractor shall schedule its design and construction packaging plan to meet the contract completion period. This submission is the Government's primary opportunity to review the design for conformance to the solicitation and to the accepted contract proposal and to the Building Codes at a point where required revisions may be still made, while minimizing lost design effort to keep the design on track with the contract requirements. The requirements for the interim design review submittals and review conferences are described hereinafter. This is not necessarily a hold point for the design process; the Contractor may designate the interim design submittal(s) as a snapshot and proceed with design development at its own risk. See below for a waiver, where the parties establish an effective over-the-shoulder progress review procedure through the partnering process that would eliminate the need for or expedite a formal intermediate design review on one or more individual design packages.

### 3.2.3. Over-the-Shoulder Progress Reviews

To facilitate a streamlined design-build process, the Government and the Contractor may agree to one-on-one reviewer or small group reviews, electronically, on-line (if available within the Contractor's standard design practices) or at the Contractor's design offices or other agreed location, when practicable to the parties. The Government and Contractor will coordinate such reviews to minimize or eliminate disruptions to the design process. Any data required for these reviews shall normally be provided in electronic format, rather than in hard copy. If the Government and Contractor establish and implement an effective, mutually agreeable partnering procedure for regular (e.g., weekly) over-the-shoulder review procedures that allow the Government reviewers the opportunity to keep fully informed of the progress, contents, design intent, design documentation, etc. of the design package, the Government will agree to waive or to expedite the formal intermediate design review period for that package. The Contractor shall still be required to submit the required intermediate design documentation, however the parties may agree to how that material will be provided, in lieu of a formal consolidated submission of the package. It should be noted that Government funding is extremely limited for non-local travel by design reviewers, so the maximum use of virtual teaming methods must be used. Some possible examples include electronic file sharing, interactive software with on-line or telephonic conferencing, televideo conferencing, etc. The Government must still perform its Code and Contract conformance reviews, so the Contractor is encouraged to partner with the reviewers to find ways to facilitate this process and to facilitate meeting or bettering the design-build schedule. The Contractor shall maintain a fully functional configuration management system as described herein to track design revisions, regardless of whether or not there is a need for a formal intermediate design review. The formal intermediate

review procedures shall form the contractual basis for the official schedule, in the event that the partnering process determines that the formal intermediate review process to be best suited for efficient project execution. However, the Government pledges to support and promote the partnering process to work with the Contractor to find ways to better the design schedule.

#### 3.2.4. Final Design Submissions

This submittal is required for each design package prior to Government acceptance of that design package for construction. The requirements for the final design submittal review conferences and the Government's acceptance for start of construction are described herein after.

#### 3.2.5. Design Complete Submittals

After the final design submission and review conference for a design package, revise the design package to incorporate the comments generated and resolved in the final review conferences, perform and document a back-check review and submit the final, design complete documents, which shall represent released for construction documents. The requirements for the design complete submittals are described hereinafter.

#### 3.2.6. Holiday Periods for Government Review or Actions

Do not schedule meetings, Government reviews or responses during the last two weeks of December or other designated Government Holidays (including Friday after Thanksgiving). Exclude such dates and periods from any durations specified herein for Government actions.

#### 3.2.7. Late Submittals and Reviews

If the Contractor cannot meet its scheduled submittal date for a design package, it must revise the proposed submittal date and notify the government in writing, at least one (1) week prior to the submittal, in order to accommodate the Government reviewers' other scheduled activities. If a design submittal is over one (1) day late in accordance with the latest revised design schedule, or if notification of a proposed design schedule change is less than seven (7) days from the anticipated design submission receipt date, the Government review period may be extended up to seven (7) days due to reviewers' schedule conflicts. If the Government is late in meeting its review commitment and the delay increases the Contractor's cost or delays completion of the project, the Suspension of Work and Defaults clauses provide the respective remedy or relief for the delay.

### 3.3. DESIGN CONFIGURATION MANAGEMENT

#### 3.3.1. Procedures

Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. During the design process, this will facilitate and help streamline the design and review schedule. After the final design is accepted, this process provides control of and documents revisions to the accepted design (See Special Contract Requirement: Deviating From the Accepted Design). The system shall include appropriate authorities and concurrences to authorize revisions, including documentation as to why the revision must be made. The DCM data shall be available to the Government reviewers at all times. The Contractor may use its own internal system with interactive Government concurrences, where necessary or may use the Government's "DrChecks Design Review and Checking System" (see below and Attachment C).

#### 3.3.2. Tracking Design Review Comments

Although the Contractor may use its own internal system for overall design configuration management, the Government and the Contractor shall use the DrChecks Design Review and Checking System to initiate, respond to, resolve and track Government design compliance review comments. This system may be useful for other data which needs to be interactive or otherwise available for shared use and retrieval. See Attachment C for details on how to establish an account and set-up the DrChecks system for use on the project.

#### 3.3.3. Design and Code Checklists

Develop and complete various discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists with each design submittal, as applicable, as part of the project documentation. See Section 01 45 04.00 10 Contractor Quality Control, Attachment D for a Sample Fire Protection and Life Safety Code review checklist and Attachment E for LEED SUBMITTALS.

### 3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

#### 3.4.1. General

At least one interim design submittal, review and review conference is required for each design package (except that, per paragraph 3.2.1, the Contractor may skip the interim design submission and proceed directly to final design on the sitework and utilities package). The DB Contractor may include additional interim design conferences or over-the-shoulder reviews, as needed, to assure continued government concurrence with the design work. Include the interim submittal review periods and conferences in the project schedule and indicate what part of the design work is at what percentage of completion. The required interim design conferences shall be held when interim design requirements are reached as described below. See also Paragraph: **Over-the-Shoulder Progress Reviews** for a waiver to the formal interim design review.

#### 3.4.2. Procedures

After receipt of an Interim Design submission, allow the Government fourteen (14) calendar days after receipt of the submission to review and comment on the interim design submittal. For smaller design packages, especially those that involve only one or a few separate design disciplines, the parties may agree on a shorter review period or alternative review methods (e.g., over-the-shoulder or electronic file sharing), through the partnering process. For each interim design review submittal, the COR will furnish, to the Contractor, a single consolidated, validated listing of all comments from the various design sections and from other concerned agencies involved in the review process using the DrChecks Design Review and Checking System. The review will be for conformance with the technical requirements of the solicitation and the Contractor's RFP proposal. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he/she must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after receipt of these comments in order that the comment can be resolved. Furnish disposition of all comments, in writing, through DrChecks. The Contractor is cautioned that if it believes the action required by any comment exceeds the requirements of this contract, that it should take no action and notify the COR in writing immediately. The Interim Review conference will be held for each design submittal at the installation. Bring the personnel that developed the design submittal to the review conference. The conference will take place the week after the receipt of the comments by the Contractor. For smaller fast-track packages that involve only a few reviewers, the parties may agree to alternative conferencing methods, such as teleconferencing, or televideo, where available, as determined through Partnering.

#### 3.4.3. Conference Documentation

3.4.3.1. In order to facilitate and accelerate the Government code and contract conformance reviews, identify, track resolution of and maintain all comments and action items generated during the design process and make this available to the designers and reviewers prior to the Interim and subsequent design reviews.

3.4.3.2. The DB Contractor shall prepare meeting minutes and enter final resolution of all comments into DrChecks. Copies of comments, annotated with comment action agreed on, will be made available to all parties before the conference adjourns. Unresolved problems will be resolved by immediate follow-on action at the end of conferences. Incorporate valid comments. The Government reserves the right to reject design document submittals if comments are significant. Participants shall determine if any comments are critical enough to require further design development prior to government concurrence. Participants shall also determine how to proceed in order to obtain government concurrence with the design work presented.

### 3.5. INTERIM DESIGN REQUIREMENTS

Interim design deliverables shall include drawings, specifications, and design analysis for the part of design that the Contractor considers ready for review.

#### 3.5.1. Drawings

Include comments from any previous design conferences incorporated into the documents to provide an interim design for the "part" submitted.

### 3.5.2. Design Analyses

3.5.2.1. The designers of record shall prepare and present design analyses with calculations necessary to substantiate and support all design documents submitted. Address design substantiation required by the applicable codes and references and pay particular attention to the following listed items:

3.5.2.2. For parts including sitework, include site specific civil calculations.

3.5.2.3. For parts including structural work, include structural calculations.

- (a) Identify all loads to be used for design.
- (b) Describe the method of providing lateral stability for the structural system to meet seismic and wind load requirements. Include sufficient calculations to verify the adequacy of the method.
- (c) Provide calculations for all principal roof, floor, and foundation members and bracing and secondary members.
- (d) Provide complete seismic analyses for all building structural, mechanical, electrical, architectural, and building features as dictated by the seismic zone for which the facility is being constructed.
- (e) Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.
- (f) See also the Security (Anti-Terrorism) requirements below for members subject to Anti-Terrorist Force Protection (ATFP) and Progressive Collapse requirements.
- (g) Fully coordinate and integrate the overall structural design between two different or interfacing construction types, such as modular and stick-built or multistory, stacked modular construction. Provide substantiation of structural, consolidation/settlement analysis, etc., as applicable, through the interfaces.

3.5.2.4. For Security (Anti-Terrorism): Provide a design narrative and calculations where applicable, demonstrating compliance with each of the 22 standards in UFC 4-010-01, which includes Design of Buildings to Resist Progressive Collapse (use the most recent version of UFC 4-023-03, regardless of references to any specific version in UFC 4-010-01). Where sufficient standoff distance is not being provided, show calculations for blast resistance of the structural system and building envelope. Show complete calculations for members subjected to ATFP loads, e.g., support members of glazed items (jambes, headers, sills) connections of windows to support members and connections of support members to the rest of the structure. For 3 story and higher buildings, provide calculations to demonstrate compliance with progressive collapse requirements.

3.5.2.5. For parts including architectural work, include building floor area analysis.

3.5.2.6. For parts including mechanical work, include HVAC analysis and calculations. Include complete design calculations for mechanical systems. Include computations for sizing equipment, compressed air systems, air duct design, and U-factors for ceilings, roofs and exterior walls and floors. Contractor shall employ commercially available energy analysis techniques to determine the energy performance of all passive systems and features. Use of hourly energy load computer simulation is required (see paragraph 3.5.5.2 for list of acceptable software). Based on the results of calculations, provide a complete list of the materials and equipment proposed with the manufacturer's published cataloged product installation specifications and roughing-in data.

3.5.2.7. For parts including life safety, include building code analysis and sprinkler and other suppression systems. Notwithstanding the requirements of the Codes, address the following:

- (a) A registered fire protection engineer (FPE) must perform all fire protection analyses. Provide the fire protection engineer's qualifications. See Section 01 10 00, paragraph 5 for qualifications.

- (b) Provide all references used in the design including Government design documents and industry standards used to generate the fire protection analysis.
- (c) Provide classification of each building in accordance with fire zone, building floor areas and height and number of stories.
- (d) Provide discussion and description of required fire protection requirements including extinguishing equipment, detection equipment, alarm equipment and water supply. Alarm and detection equipment shall interface to requirements of Electronic Systems.
- (e) Provide hydraulic calculations based on water flow test for each sprinkler system to insure that flow and pressure requirements can be met with current water supply. Include copies of Contractor's water flow testing done to certify the available water source.

3.5.2.8. For parts including plumbing systems:

- (a) List all references used in the design.
- (b) Provide justification and brief description of the types of plumbing fixtures, piping materials and equipment proposed for use.
- (c) Detail calculations for systems such as sizing of domestic hot water heater and piping; natural gas piping; LP gas piping and tanks, fuel oil piping and tanks, etc., as applicable.
- (d) When the geotechnical report indicates expansive soils are present, indicate in the first piping design submittal how piping systems will be protected against damage or backfall/backflow due to soil heave (from penetration of slab to the 5 foot building line).

3.5.2.9. For elevator systems:

- (a) List all criteria codes, documents and design conditions used.
- (b) List any required permits and registrations for construction of items of special mechanical systems and equipment.

3.5.2.10. For parts including electrical work, include lighting calculations to determine maintained foot-candle levels, electrical load analysis and calculations, electrical short circuit and protective device coordination analysis and calculations and arc fault calculations.

3.5.2.11. For parts including telecommunications voice/data (including SIPRNET, where applicable), include analysis for determining the number and placement of outlets

3.5.2.12. For Cathodic Protection Systems, provide the following stamped report by the licensed corrosion engineer or NACE specialist with the first design submission. The designer must be qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. He/she must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection Specialist, or must be a registered professional engineer with a minimum of five years experience in corrosion control and cathodic protection. Clearly describe structures, systems or components in soil or water to be protected. Describe methods proposed for protection of each.

3.5.2.13. Air Barrier System: Provide a narrative of the design and installation requirements for the Air Barrier system. As part of the design quality control process an air barrier consultant shall review drawing details to assure that details of critical Air Barrier components are properly detailed and incorporated during the design drawings and process (i.e. window flashing details, penetration in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.). Furnish the Government written review details and results.

3.5.3. Geotechnical Investigations and Reports:

3.5.3.1. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal. Make this information available as early as possible during the over-the-shoulder progress review process. Summarize the subsurface conditions and provide recommendations for the design of appropriate utilities, foundations, floor slabs, retaining walls, embankments, and pavements. Include compaction requirements for fill and backfill under buildings, sidewalks, other structures and open areas. Recommend foundation systems to be used, allowable bearing pressures for footings, lateral load

resistance capacities for foundation systems, elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential including total and differential. Provide recommendations regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Include calculations to support the recommendations for bearing capacity, settlement, and pavement sections. Include supporting documentation for all recommended design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. Provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control and the possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Include the raw field data. Arrange a meeting with the Government subsequent to completion and evaluation of the site specific geotechnical exploration to outline any differences encountered that are inconsistent with the Government provided preliminary soils information. Clearly outline differences which require changes in the foundation type, or pavement and earthwork requirements from that possible and contemplated using the Government furnished preliminary soils investigation, which result in a change to the design or construction. Any equitable adjustment is subject to the provisions of the contract's Differing Site Conditions Clause.

3.5.3.2. Vehicle Pavements: The Contractor's geotechnical report shall contain flexible and rigid pavement designs, as applicable for the project, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades and pavement layers. Provide Information on the types of base course materials available in the area and design strengths.

3.5.3.3. The Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor's final geotechnical report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

#### 3.5.4. LEED Documentation:

Assign a LEED Accredited Professional, responsible to track LEED planning, performance and documentation for each LEED credit through construction closeout. Incorporate LEED credits in the plans, specifications and design analyses. Develop LEED supporting documentation as a separable portion of the Design Analysis and provide with each required design submittal. Include the LEED Project checklist for each non-exempt facility (one checklist may be provided for multiple facilities in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects and the LEED SUBMITTALS (Attachment E, herein) with each submittal. Final design submittal for each portion of the work must include all required design documentation relating to that portion of work (example - all site credit design documents with final site design). Submittal requirements are as indicated in Attachment E, LEED SUBMITTALS. Submit all documentation indicated on Attachment E as due at final design at final design submittal (for fast-track projects with multiple final design submittals, this shall be at the last scheduled final design submittal). All project documentation related to LEED shall conform to USGBC requirements for both content and format, including audit requirements and be separate from other design analyses. Maintain and update the LEED documentation throughout project progress to construction closeout and shall compile product data, receipts, calculations and other data necessary to substantiate and support all credits claimed. The Government may audit any or all individual credits. Audit documentation is not required to be submitted unless requested. These requirements apply to all projects. If the project requires the Contractor to obtain USGBC certification, the Contractor shall also be responsible for obtaining USGBC certification and shall provide written evidence of certification with the construction closeout LEED documentation submittal. Install the USGBC building plaque at the location indicated by the Government upon receipt. If Contractor obtains USGBC interim design review, submit the USGBC review to the Government within 30 days of receipt for information only.

3.5.4.1. LEED Documentation for Technology Solution Set. If the Solicitation provides a Prescriptive Technology Solution Set, use of the Technology Solution set has no effect on LEED documentation requirements. Provide all required LEED documentation, including energy analysis, in accordance with LEED requirements when using the Technology Solution Set.

#### 3.5.5. Energy Conservation:



3.5.5.1. Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals shall demonstrate that each building including the building envelope, HVAC systems, service water heating, power, and lighting systems meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Use Compliance Documentation forms available from ASHRAE and included in the ASHRAE 90.1 User's Manual for this purpose. The Architectural Section of the Design Analysis shall include completed forms titled "Building Envelope Compliance Documentation Parts I and II". The Heating Ventilating and Air Conditioning (HVAC) Section of the Design Analysis shall include a completed form titled "HVAC Simplified Approach Option - Part I" if this approach is allowed by the Standard. Otherwise, the HVAC Section of the Design Analysis shall include completed forms titled "HVAC Mandatory Provisions - Part II" and "HVAC Prescriptive Requirements - Part III". The Plumbing Section of the Design Analysis shall include a completed form titled "Service Water Heating Compliance Documentation". The Electrical Section of the Design Analysis shall include an explanatory statement on how the requirements of ASHRAE 90.1-2007 Chapter 8 Power were met. The Electrical Section of the Design Analysis shall also include a completed form titled "Lighting Compliance Documentation".

3.5.5.2. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must also include calculations in a separate Energy Conservation Section of the Design Analysis which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. Use the USGBC Energy and Atmosphere (EA) Credit 1 compliance template / form or an equivalently detailed form for documenting compliance with the energy reduction requirements. This template / form is titled PERFORMANCE RATING METHOD and is available when the project is registered for LEED. The calculation methodology used for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Include laboratory fume hoods and kitchen ventilation loads in the energy calculation. They are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

### 3.5.6. Specifications

Specifications may be any one of the major, well known master guide specification sources (use only one source) such as MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. (including specifications from these sources). Manufacturers' product specifications, utilizing CSI's Manu-Spec, three part format may be used in conjunction with the selected specifications. The designers of record shall edit and expand the appropriate Specifications to insure that all project design requirements, current code requirements, and regulatory requirements are met. Specifications shall clearly identify, where appropriate, specific products chosen to meet the contract requirements (i.e., manufacturers' brand names and model numbers or similar product information).

### 3.5.7. Building Rendering

Present and provide a draft color computer, artist, or hand drawn rendering with the conceptual design submittal of the building exterior. Perspective renderings shall include a slightly overhead view of the entire building to encompass elevations and the roof configuration of the building. After Government review and acceptance, provide a final rendering, including the following:

Three (3) 18" x 24" color prints, framed and matted behind glass with project title underneath the print.

One (1) Image file (high resolution) in JPG format on CD for those in the submittal distribution list.

### 3.5.8. Interim Building Design Contents

The following list represents what the Government considers should be included in the overall completed design for a facility or project. It is not intended to limit the contractor from providing different or additional information as needed to support the design presented, including the required design analyses discussed above. As the Contractor develops individual design packages and submits them for Interim review, include as much of the applicable information for an individual design package as is developed at the Interim design level for review purposes. These pieces shall be developed as the design progresses toward the design complete stage.

#### 3.5.8.1. Lawn and Landscaping Irrigation System

#### 3.5.8.2. Landscape, Planting and Turfing

#### 3.5.8.3. Architectural

- (a) Design Narrative
- (b) Architectural Floor Plans, Typical Wall and Roof Sections, Elevations
- (c) Finish schedule
- (d) All required equipment
- (e) Special graphics requirements
- (f) Door and Window Schedules
- (g) Hardware sets using BHMA designations
- (h) Composite floor plan showing all pre-wired workstations
- (i) Structural Interior Design (SID) package: See ATTACHMENT A for specific requirements
- (j) Furniture, Fixtures & Equipment (FF&E) design package: See ATTACHMENT B for specific requirements
- (k) Air Barrier Design: Details of all Air Barrier components, (i.e. window flashing details, penetrations in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.)

#### 3.5.8.4. Structural Systems. Include:

- (a) Drawings showing principal members for roof and floor framing plans as applicable
- (b) Foundation plan showing main foundation elements where applicable
- (c) Typical sections for roof, floor, and foundation conditions

#### 3.5.8.5. Plumbing Systems

- (a) Show locations and general arrangement of plumbing fixtures and major equipment
- (b) Plan and isometric riser diagrams of all areas including hot water, cold water, waste and vent piping. Include natural gas (and meter as required), (natural gas and meter as required), (LP gas), (fuel oil) and other specialty systems as applicable.
- (c) Include equipment and fixture connection schedules with descriptions, capacities, locations, connection sizes and other information as required

#### 3.5.8.6. HVAC Systems

- (a) Mechanical Floor Plans: The floor plans shall show all principle architectural features of the building which will affect the mechanical design. The floor plans shall also show the following:
  - (1) Room designations.
  - (2) Mechanical legend and applicable notes.
  - (3) Location and size of all ductwork and piping.
  - (4) Location and capacity of all terminal units (i.e., registers, diffusers, grilles, hydronic baseboards).
  - (5) Pre-Fabricated Paint Spray Booth (where applicable to project scope)
  - (6) Paint Preparation Area (where applicable to project scope)

- (7) Exhaust fans and specialized exhaust systems.
- (8) Thermostat location.
- (9) Location of heating/cooling plant (i.e., boiler, chiller, cooling tower, etc).
- (10) Location of all air handling equipment.
- (11) Air balancing information.
- (12) Flue size and location.
- (13) Piping diagram for forced hot water system (if used).
- (b) Equipment Schedule: Provide complete equipment schedules. Include:
  - (1) Capacity
  - (2) Electrical characteristics
  - (3) Efficiency (if applicable)
  - (4) Manufacturer's name
  - (5) Optional features to be provided
  - (6) Physical size
  - (7) Minimum maintenance clearances
- (a) Details: Provide construction details, sections, elevations, etc., only where required for clarification of methods and materials of design.
- (b) HVAC Controls: Submit complete HVAC controls equipment schedules, sequences of operation, wiring and logic diagrams, Input/Output Tables, equipment schedules, and all associated information. See the Statement of Work for additional specific requirements.

#### 3.5.8.7. Fire Protection and Life Safety.

- (a) Provide plan for each floor of each building that presents a compendium of the total fire protection features being incorporated into the design. Include the following types of information:
  - (1) The location and rating of any fire-resistive construction such as occupancy separations, area separations, exterior walls, shaft enclosures, corridors, stair enclosures, exit passageways, etc.
  - (2) The location and coverage of any fire detection systems
  - (3) The location and coverage of any fire suppression systems (sprinkler risers, standpipes, etc.)
  - (4) The location of any other major fire protection equipment
  - (5) Indicate any hazardous areas and their classification
  - (6) Schedule describing the internal systems with the following information: fire hazard and occupancy classifications, building construction type, GPM/square foot sprinkler density, area of operation and other as required
- (b) Working plans and all other materials submitted shall meet NFPA 13 requirements, with respect to required minimum level of detail.

#### 3.5.8.8. Elevators. Provide:

- (a) Description of the proposed control system
- (b) Description, approximate capacity and location of any special mechanical equipment for elevators.

#### 3.5.8.9. Electrical Systems.

- (a) Electrical Floor Plan(s): Show all principle architectural features of the building which will affect the electrical design. Show the following:
  - (1) Room designations.

- (2) Electrical legend and applicable notes.
- (3) Lighting fixtures, properly identified.
- (4) Switches for control of lighting.
- (5) Receptacles.
- (6) Location and designation of panelboards. Clearly indicate type of mounting required (flush or surface) and reflect accordingly in specifications.
- (7) Service entrance (conduit and main disconnect).
- (8) Location, designation and rating of motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.
- (b) Building Riser Diagram(s) (from pad-mounted transformer to unit load center panelboard): Indicate the types and sizes of electrical equipment and wiring. Include grounding and metering requirements.
- (c) Load Center Panelboard Schedule(s): Indicate the following information:
  - (1) Panelboard Characteristics (Panel Designation, Voltage, Phase, Wires, Main Breaker Rating and Mounting).
  - (2) Branch Circuit Designations.
  - (3) Load Designations.
  - (4) Circuit Breaker Characteristics. (Number of Poles, Trip Rating, AIC Rating)
  - (5) Branch Circuit Connected Loads (AMPS).
  - (6) Special Features
- (d) Lighting Fixture Schedule(s): Indicate the following information:
  - (1) Fixture Designation.
  - (2) General Fixture Description.
  - (3) Number and Type of Lamp(s).
  - (4) Type of Mounting.
  - (5) Special Features.
- (e) Details: Provide construction details, sections, elevations, etc. only where required for clarification of methods and materials of design.

3.5.8.10. Electronic Systems including the following responsibilities:

- (a) Fire Detection and Alarm System. Design shall include layout drawings for all devices and a riser diagram showing the control panel, annunciator panel, all zones, radio transmitter and interfaces to other systems (HVAC, sprinkler, etc.)
- (b) Fire Suppression System Control. Specify all components of the Fire Suppression (FS) System in the FS section of the specifications. Clearly describe how the system will operate and interact with other systems such as the fire alarm system. Include a riser diagram on the drawings showing principal components and interconnections with other systems. Include FS system components on drawing legend. Designate all components shown on floor plans "FS system components" (as opposed to "Fire Alarm components"). Show location of FS control panels, HVAC control devices, sensors, and 120V power panel connections on floor plans. Indicate zoning of areas by numbers (1, 2, 3) and detectors sub-zoned for cross zoning by letter designations (A and B). Differentiate between ceiling mounted and under floor detectors with distinct symbols and indicate sub-zone of each.
- (c) Public Address System
- (d) Special Grounding Systems. Completely reflect all design requirements in the specifications and drawings. Specifications shall require field tests (in the construction phase), witnessed by the Government, to determine the effectiveness of the grounding system. Include drawings showing existing construction, if any.
- (e) Cathodic Protection.

- (f) Intrusion Detection, Card Access System
- (g) Central Control and Monitoring System
- (h) Mass Notification System
- (i) Electrical Power Distribution Systems

3.5.8.11. Separate detailed Telecommunications drawings for Information Systems including the following responsibilities:

- (a) Telecommunications Cabling
- (b) Supporting Infrastructure
- (a) Outside Plant (OSP) Cabling - Campus or Site Plans - Exterior Pathways and Inter-Building Backbones
  - (a) Include a layout of the voice/data outlets (including voice only wall & pay phones) on telecommunication floor plan drawing, location of SIPRNET data outlets (where applicable), and a legend and symbol definition to indicate height above finished floor. Show size of conduit and cable type and size on Riser Diagram. Do not show conduit runs between backboard and outlets on the floor plans. Show underground distribution conduit and cable with sizing from point of presence to entrance facility of building.
  - (b) Layout of complete building per floor - Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways including Serving Zones Drawings - Drop Locations and Cable ID's
  - (c) Communication Equipment Rooms - Plan Views - Tech and AMEP/Elevations - Racks and Walls. Elevations with a detailed look at all telecomm rooms. Indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. They may also be an enlargement of a congested area of T1 or T2 series drawing.

### 3.6. FINAL DESIGN REVIEWS AND CONFERENCES

A final design review and review conference will be held upon completion of final design at the project installation, or – where equipment is available - by video teleconference or a combination thereof, for any design package to receive Government acceptance to allow release of the design package for construction. For smaller separate design packages, the parties may agree on alternative reviews and conferences (e.g., conference calls and electronic file sharing, etc.) through the Partnering process. Include the final design conference in the project schedule and shall indicate what part of the design work is at 100% completion. The final design conference will be held after the Government has had seven (7) calendar days after receipt of the submission to review the final design package and supporting data. For smaller packages, especially those involving only one or a few design disciplines the parties may agree on a shorter period.

### 3.7. FINAL DESIGN REQUIREMENTS

Final design deliverables for a design package shall consist of 100% complete drawings, specifications, submittal register and design analyses for Government review and acceptance. The 100% design submission shall consist of drawings, specifications, updated design analyses and any permits required by the contract for each package submitted. In order to expedite the final design review, prior to the conference, ensure that the design configuration management data and all review comment resolutions are up-to-date. Include the 100% SID and 100% FF&E binders for government approval. The Contractor shall have performed independent technical reviews (ITR's) and back-checks of previous comment resolutions, as required by Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL, including providing documentation thereof. Use DrChecks or other acceptable comment tracking system during the ITR and submit the results with each final design package

#### 3.7.1. Drawings

3.7.1.1. Submit drawings complete with all contract requirements incorporated into the documents to provide a 100% design for each package submitted.

3.7.1.2. Prepare all drawings with the Computer-Aided Design and Drafting (CADD)/Computer-Aided Design (CAD) system, organized and easily referenced electronically, presenting complete construction information.

3.7.1.3. Drawings shall be complete. The Contractor is encouraged to utilize graphics, views, notes, and details which make the drawings easier to review or to construct but is also encouraged to keep such materials to those that are necessary.

3.7.1.4. Provide detail drawings that illustrate conformance with the contract. Include room finish schedules, corresponding color/finish/special items schedules, and exterior finish schedules that agree with the submitted SID binders.

3.7.1.5. The design documents shall be in compliance with the latest version of the A/E/C CAD Standard, available at <https://cadbim.usace.army.mil/CAD>. Use the approved vertical Corps of Engineers title blocks and borders on all drawings with the appropriate firm name included within the title block area.

3.7.1.6. CAD System and Building Information Modeling (BIM) (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order.)

All CAD files shall be fully compatible with MicroStation V8 or higher. Save all design CAD files as MicroStation V8 or higher files. All submitted BIM Models and associated Facility Data shall be fully compatible with Bentley BIM file format and the USACE Bentley BIM v8 Workspace.

(a) CAD Data Final File Format: During the design development capture geo-referenced coordinates of all changes made to the existing site (facility footprint, utility line installations and alterations, roads, parking areas, etc) as a result of this contract. There is no mandatory methodology for how the geo-referenced coordinates will be captured, however, Engineering and Construction Bulletin No. 2006-15, Subject: Standardizing Computer Aided Design (CAD) and Geographic Information Systems (GIS) Deliverables for all Military Design and Construction Projects identifies the format for final as-built drawings and data sets to be delivered to the government. Close-out requirements at the as-built stage; require final geo-referenced GIS Database of the new facility along with all exterior modifications. The Government will incorporate this data set into the Installation's GIS Masterplan or Enterprise GIS System. See also, Section 01 78 02.00 10 Closeout Submittals.

(b) Electronic Drawing Files: In addition to the native CAD design files, provide separate electronic drawing files (in editable CAD format and Adobe Acrobat PDF version 7.0 or higher) for each project drawing.

(c) Each file (both CAD and PDF) shall represent one complete drawing from the drawing set, including the date, submittal phase, and border. Each drawing file shall be completely independent of any data in any other file, including fonts and shapes not included with the basic CAD software program utilized. Fonts that are not included as part of the default CAD software package installation or recognized as an allowable font by the A/E/C CAD Standard are not acceptable in delivered CAD files. All displayed graphic elements on all levels of the drawing files shall be part of the project drawing image. The drawing files shall not contain any graphic element that is not part of the drawing image.

(d) Deliver BIM Model and associated Facility Data files in their native format. At a minimum, BIM files shall address major architecture design elements, major structural components, mechanical systems and electrical/communication distribution and elements as defined in Attachment F. See Attachment F for additional BIM requirements.

(e) Drawing Index: Provide an index of drawings sheet in CAD as part of the drawing set, and an electronic list in Microsoft Excel of all drawings on the CD. Include the electronic file name, the sheet reference number, the sheet number, and the sheet title, containing the data for each drawing.

(f) Hard Copies: Plot submitted hard copy drawings directly from the "electronic drawing files" and copy for quantities and sizes indicated in the distribution list at the end of this specification section. The Designers of Record shall stamp, sign and date original hard copy sheets as Released For Construction, and provide copies for distribution from this set.

### 3.7.2. Design Analyses

3.7.2.1. The designers of record shall update, finalize and present design analyses with calculations necessary to substantiate and support all design documents submitted.

3.7.2.2. The responsible DOR shall stamp, sign and date the design analysis. Identify the software used where, applicable (name, version, vendor). Generally, provide design analyses, individually, in an original (file copy) and one copy for the assigned government reviewer.

3.7.2.3. All disciplines review the LEED design analysis in conjunction with their discipline-specific design analysis; include a copy of the separable LEED design analysis in all design analysis submittals.

3.7.2.4. Do not combine multi-disciplined volumes of design-analysis, unless multiple copies are provided to facilitate multiple reviewers (one copy per each separate design analysis included in a volume).

### 3.7.3. Specifications

Specifications shall be 100% complete and in final form.

### 3.7.4. Submittal Register

Prepare and update the Submittal Register and submit it with the 100% design specifications (see Specification Section 01 33 00, SUBMITTAL PROCEDURES) with each design package. Include the required submittals for each specification section in a design package in the submittal register.

### 3.7.5. Preparation of DD Form 1354 (Transfer of Real Property)

This form itemizes the types, quantities and costs of various equipment and systems that comprise the project, for the purpose of transferring the new construction project from the Corps Construction Division to the Installation's inventory of real property. The Government will furnish the DB Contractor's design manager a DD Form 1354 checklist to use to produce a draft Form 1354. Submit the completed checklist and prepared draft Form DD 1354 with the 100% design in the Design Analysis. The Corps will use these documents to complete the final DD 1354 upon completion of construction.

### 3.7.6. Acceptance and Release for Construction

3.7.6.1. At the conclusion of the Final Design Review (after resolutions to the comments have been agreed upon between DOR and Government reviewers), the Contracting Officer or the ACO will accept the Final Design Submission for the design package in writing and allow construction to start for that design package. The Government may withhold acceptance until all major corrections have been made or if the final design submission requires so many corrections, even though minor, that it isn't considered acceptably complete.

3.7.6.2. Government review and acceptance of design submittals is for contract conformance only and shall not relieve the Contractor from responsibility to fully adhere to the requirements of the contract, including the Contractor's accepted contract proposal, or limit the Contractor's responsibility of design as prescribed under Special Contract Requirement: "Responsibility of the Contractor for Design" or limit the Government's rights under the terms of the contract. The Government reserves the right to rescind inadvertent acceptance of design submittals containing contract deviations not separately and expressly identified in the submittal for Government consideration and approval.

## 3.8. DESIGN COMPLETE CONSTRUCTION DOCUMENT REQUIREMENTS

After the Final Design Submission and Review Conference and after Government acceptance of the Final Design submission, revise the design documents for the design package to incorporate the comments generated and resolved in the final review conference, perform and document a back-check review and submit the final, design complete documents. Label the final design complete documents "FOR CONSTRUCTION" or use similar language. In addition to the final drawings and specifications, the following deliverables are required for distribution and field use. The deliverable includes all documentation and supporting design analysis in final form, as well as the final review comments, disposition and the back-check. As part of the quality assurance process, the Government may perform a back-check of the released for construction documentation. Promptly correct any errors or omissions found during the Government back-check. The Government may withhold retainage from progress payments for work or materials associated with a final design package until this submittal has been received and the Government determines that it is complete.

## 3.9. SUBMITTAL DISTRIBUTION, MEDIA AND QUANTITIES

### 3.9.1. Submittal Distribution and Quantities

General: The documents which the Contractor shall submit to the Government for each submittal are listed and generally described in preceding paragraphs in this Section. Provide copies of each design submittal and design substantiation as follows (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order):

| Activity and Address  | Drawing Size (Full Size)<br><b>Full Size</b><br>Full Sets/<br>*Partial Sets | Design Analyses & Specs<br>Full Sets/<br>*Partial Sets | Drawing Size (Half Size)<br><b>Half Size</b><br>Full Sets/<br>*Partial Sets | Non-BIM Data<br>CD-ROM or DVD as Necessary<br>(PDF & <u>.dgn</u> ) | Furniture Submittal<br>(Per Attachment B) | Structural Interior Design Submittal | BIM Data DVD<br>(Per Attachment F) |
|---|---|--|---|--|---|--------------------------------------|------------------------------------|
| Commander, U.S. Army Engineer District<br><b>Fort Worth District Corps of Engineers</b> | 1/0   | 6/0  | 6/0   | 6  | 1   | 1                                    | 1                                  |
| Commander, U.S. Army Engineer District, Center of Standardization<br><b>Fort Worth</b>  | 1/0   | 1/0  | 1/0   | 6  | N/A                                       | 2                                    | 1                                  |
| Installation  | 1/0   | 11/0   | 11/0  | 10   | 2   | 2                                    | 1                                  |
| U.S. Army Corps of Engineers Construction Area Office                                   | 1/0   | 4/0  | 4/0   | 4  | 1   | 1                                    | 1                                  |
| Information Systems Engineering Command (ISEC)  | 0/0   | 0/0  | 0/0   | 1  | N/A                                       | N/A                                  | 1                                  |
| Other Offices   | 0/0   | 0/0  | 0/0   | 1  | N/A                                       | 0                                    | 1                                  |

**\*NOTE: For partial sets of drawings, specifications and design analyses, see paragraph 3.9.3.3, below.**

**\*\*NOTE: When specified below in 3.9.2, furnish Installation copies of Drawings as paper copies, in lieu of the option to provide secure web-based submittals.**

### 3.9.2. Web based Design Submittals

Except for full or half-sized drawings for Installation personnel, as designated in the Table above, Web based design submittals will be acceptable as an alternative to the paper copies listed in the Table above, provided a single hard-copy PDF based record set is provided to the Contracting Officer for record purposes. Where the contract requires the Contractor to submit documents to permitting authorities, still provide those authorities paper copies (or in an alternate format where required by the authority). Web based design submittal information shall be provided with adequate security and availability to allow unlimited access those specifically authorized to Government reviewers while preventing unauthorized access or modification. File sizes must be of manageable



size for reviewers to quickly download or open on their computers. As a minimum, drawings shall be full scale on American National Standards Institute (ANSI) D sheets (34" x 22"). In addition to the optional website, provide the BIM data submission on DVD to each activity and address noted above in paragraph 3.9.1 for each BIM submission required in Attachment F.

### 3.9.3. Mailing of Design Submittals

3.9.3.1. Mail all design submittals to the Government during design and construction, using an overnight mailing service. The Government will furnish the Contractor addresses where each copy shall be mailed to after award of the contract (or individual task order if this is an indefinite delivery/indefinite quantity, task order contract). Mail the submittals to six (6) different addresses. Assemble drawing sheets, specs, design analyses, etc. into individual sets; do not combine duplicate pages from individual sets so that the government has to assemble a set.

3.9.3.2. Each design submittal shall have a transmittal letter accompanying it indicating the date, design percentage, type of submittal, list of items submitted, transmittal number and point of contact with telephone number.

3.9.3.3. Provide partial sets of drawings, specifications, design analyses, etc., as designated in the Table in paragraph 3.9.1, to those reviewers who only need to review their applicable portions of the design, such as the various utilities. The details of which office receives what portion of the design documentation will be worked out after award.

### 3.10. AS-BUILT DOCUMENTS

Provide as-built drawings and specifications in accordance with Section 01 78 02.00 10, CLOSEOUT SUBMITTALS. Update LEED design phase documentation during construction as needed to reflect construction changes and advancing project completion status (example - Commissioning Plan updates during construction phase) and include updated LEED documentation in construction closeout submittal.

## **ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS**

### **1.0 GENERAL INFORMATION**

Structural Interior Design includes all building related elements and components generally part of the building itself, such as wall finishes, ceilings finishes, floor coverings, marker/bulletin boards, blinds, signage and built in casework. Develop the SID in conjunction with the furniture footprint.

### **2.0 STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS**

#### **2.1. FORMAT AND SCHEDULE**

Prepare and submit for approval an interior and exterior building finishes scheme for an interim design submittal. The DOR shall meet with and discuss the finish schemes with the appropriate Government officials prior to preparation of the schemes to be presented. Present original sets of the schemes to reviewers at an interim design conference.

At the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers, the Contractor may proceed to final design with the interior finishes scheme presented.

The SID information and samples are to be submitted in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover. When there are numerous pages with thick samples, use more than one binder. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Structural Interior Design" package. Include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Design submittal requirements include, but are not limited to:

##### **2.1.1. Narrative of the Structural Interior Design Objectives**

The SID shall include a narrative that discusses the building related finishes. Include topics that relate to base standards, life safety, sustainable design issues, aesthetics, durability and maintainability, discuss the development and features as they relate to the occupants requirements and the building design.

##### **2.1.2. Interior Color Boards**

Identify and key each item on the color boards to the contract documents to provide a clear indication of how and where each item will be used. Arrange finish samples to the maximum extent possible by room type in order to illustrate room color coordination. Label all samples on the color boards with the manufacturer's name, patterns and colors name and number. Key or code samples to match key code system used on contract drawings.

Material and finish samples shall indicate true pattern, color and texture. Provide photographs or colored photocopies of materials or fabrics to show large overall patterns in conjunction with actual samples to show the actual colors. Finish samples must be large enough to show a complete pattern or design where practical.

Color boards shall include but not be limited to original color samples of the following:

All walls finishes and ceiling finishes, including corner guards, acrylic wainscoting and wall guards/chair rail finishes

All tile information, including tile grout color and tile patterns.

- All flooring finishes, including patterns.
- All door, door frame finishes and door hardware finishes
- All signage, wall base, toilet partitions, locker finishes and operable/folding partitions and trim

- All millwork materials and finishes (cabinets, counter tops, etc.)
- All window frame finishes and window treatments (sills, blinds, etc.)

Color board samples shall reflect all actual finish textures, patterns and colors required as specified. Patterned samples shall be of sufficient size to adequately show pattern and its repeat if a repeat occurs.

#### 2.1.3. Exterior Color Boards

Prepare exterior finishes color boards in similar format as the interior finishes color boards, for presentation to the reviewers during an interim design conference. Provide original color samples of all exterior finishes including but not limited to the following:

- All Roof Finishes
- All Brick and Cast Stone Samples
- All Exterior Insulation and Finish Samples
- All Glass Color Samples
- All Exterior Metals Finishes
- All Window & Door Frame Finishes
- All Specialty Item Finishes, including trim

Identify each item on the exterior finishes color boards and key to the building elevations to provide a clear indication of how and where each item will be used.

### 2.2. STRUCTURAL INTERIOR DESIGN DOCUMENTS

#### 2.2.1. General

Structural interior design related drawings must indicate the placement of extents of SID material, finishes and colors and must be sufficiently detailed to define all interior work. The following is a list of minimum requirements:

#### 2.2.2. Finish Color Schedule

Provide finish color schedule(s) in the contract documents. Provide a finish code, material type, manufacturer, series, and color designations. Key the finish code to the color board samples and drawings.

#### 2.2.3. Interior Finish Plans

Indicate wall and floor patterns and color placement, material transitions and extents of interior finishes.

#### 2.2.4. Furniture Footprint Plans

Provide furniture footprint plans showing the outline of all freestanding and systems furniture for coordination of all other disciplines.

#### 2.2.5. Interior Signage

Include interior signage plans or schedules showing location and quantities of all interior signage. Key each interior sign to a quantitative list indicating size, quantity of each type and signage text.

#### 2.2.6. Interior Elevations, Sections and Details

Indicate material, color and finish placement.

## **ATTACHMENT B FURNITURE, FIXTURES & EQUIPMENT (FF&E) REQUIREMENTS**

### **1.0 FF&E REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS**

#### **1.1. FORMAT AND SCHEDULE**

Prepare and submit for approval a comprehensive FF&E scheme for an interim design submittal. The Contractor's interior designer, not a furniture dealer, shall develop the design. FF&E is the selection, layout, specification and documentation of furniture includes but is not limited to workstations, seating, tables, storage and shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the Structural Interior Design (SID) portion of the interior design. Develop the FF&E package concurrently with the building design to ensure that there is coordination between the electrical outlets, switches, J-boxes, communication outlets and connections, and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and unless otherwise noted, do not attach furniture including furniture systems to the building. If project has SIPRNET and/or NIPRNET, coordinate furniture layout with SIPRNET and NIPRNET separation requirements. Verify that access required by DOIM for SIPRNET box and conduit is provided. The DOR shall interview appropriate Government personnel to determine FF&E requirements for furniture and furnishings prior to preparation of the scheme to be presented. Determine FFE items and quantities by, but not limited to: (1) the number of personnel to occupy the building, (2) job functions and related furniture/office equipment to support the job function, (3) room functions, (4) rank and grade. Present original sets of the scheme to reviewers at an interim design conference upon completion of the interim architectural submittal or three months prior to the submittal of the final FF&E package (whichever comes first).

Design may proceed to final with the FF&E scheme presented at the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers.

Provide six copies of the electronic versions of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide unbound, electronic drawings in CAD and BIM. Provide all files needed to view complete drawings. Submit all text documents in Microsoft Word or Excel..

Submit four copies of the final and complete FF&E information and samples in 8 1/2" x 11" format using three ring binders with pockets on the inside of the cover upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first). Use more than one binder when there are numerous pages with thick samples. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out for upholstery and finish boards. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 1/2". Provide cover and spine inserts sheets identifying the document as "Furniture, Fixtures & Equipment" package and include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Provide electronic copies of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide six compact disks with all drawings files needed to view the complete drawings unbound and in the latest version AutoCAD. Provide six additional compact disks of all text documents in Microsoft Word or Excel.

Design submittal requirements include, but are not limited to:

##### **1.1.1. Narrative of Interior Design Objectives**

Provide a narrative description of the furniture, to include functional, safety and ergonomic considerations, durability, sustainability, aesthetics, and compatibility with the building design.

##### **1.1.2. Furniture Order Form**

Prepare one Furnishings Order Form for each item specified in the design. This form identifies all information required to order each individual item. In addition to the project name and location, project number, and submittal phase, the order form must include:

- (a) Furniture item illustration and code
- (b) Furniture item name
- (c) Job name, location, and date
- (d) General Services Administration (GSA) FSC Group, part, and section
- (e) Manufacturer, Product name and Product model number or National Stock Number (NSN)
- (f) Finish name and number (code to finish samples)
- (g) Fabric name and number, minimum Wyzenbeek Abrasion Test double rubs (code to fabric samples)
- (h) Dimensions
- (i) Item location by room number and room name
- (j) Quantity per room
- (k) Total quantity
- (l) Special instructions for procurement ordering and/or installation (if applicable)
- (m) Written Product Description: include a non-proprietary paragraph listing the salient features of the item to include but not limited to:
  - (1) required features and characteristics
  - (2) ergonomic requirements
  - (3) functional requirements
  - (4) testing requirements
  - (5) furniture style
  - (6) construction materials
  - (7) minimum warranty

The following is an example for “m” features and characteristics, ergonomic requirements and functional requirements:

Chair Description:

- (1) Mid-Back Ergonomic Task Chair
- (2) Pneumatic Gaslift; Five Star Base
- (3) Mesh Back; Upholstered Seat
- (4) Height and Width Adjustable Task Arms:
  - a. Arm Height: 6”- 11” (+-1/2”)
  - b. Arm Width: 2”– 4” adjustment
- (5) Height Adjustable Lumbar Support
- (6) Adjustable Seat Height 16”-21” (+- 1”)
- (7) Sliding Seat Depth Adjustment 15”-18” (+-1”)
- (8) Standard Hard Casters (for carpeted areas)
- (9) Overall Measurements:
  - a. Overall width: 25” - 27”
  - b. Overall depth: 25”– 28”

- (10) Must have a minimum of the following adjustments (In addition to the above):
- 360 Degree Swivel
  - Knee-Tilt with Tilt Tension
  - Back angle
  - Forward Tilt
  - Forward Tilt and Upright Tilt Lock

For projects with systems furniture, also provide a written description of the following minimum requirements:

- Type furniture systems (panel, stacking panels, spine wall, desk based system, or a combination)
- Minimum noise reduction coefficient (NRC)
- Minimum sound transfer coefficient (STC)
- Minimum flame spread and smoke development
- UL testing for task lighting and electrical system
- Panel widths and heights and their locations (this may be done on the drawings) Worksurface types and sizes (this may be done on the drawings)
- Worksurface edge type
- Varying panel/cover finish materials and locations (locations may be shown on the drawings)
- Storage requirements
- Keyboard requirements
- Lock and keying requirements
- Accessory components (examples: tack boards, marker boards, paper management)
- Electrical and communication raceway requirement; type, capacity and location (base, beltline, below and/or above beltline)
- Locations of communication cables (base, beltline, below and/or above beltline, top channel)
- Types of electrical outlets
- Types of communication jacks; provided and installed by others
- Locations of electrical outlets and communication jacks (this may be done on the drawings)
- Type of cable (examples: Cat. 5, Cat. 6, fiber optic; UTP or STP, etc.) system needs to support; provided and installed by others

#### 1.1.3. Alternate Manufacturer List

Provide a table consisting of major furniture items that lists the manufacturers products specified on the Order Form and two alternate manufacturers. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name. Supply alternates that are available on GSA Schedule and meet the requirements of the Furniture Order Form. One of the two alternates must be from UNICOR if possible. Provide manufacturer name address, telephone number, product series and product name for each alternate manufacturer.

#### 1.1.4. FF&E Procurement List

Provide a table that lists all FF&E furniture, mission unique equipment and building Contractor Furnished/Contractor Installed (CF/CI) items. Give each item a code and name and designate whether item will be procured as part of the FF&E furniture, mission unique equipment or the building construction contract. Use the item code to key all FF&E documents including location plans, color boards, data sheets, cost estimate, etc.

#### 1.1.5. Points of Contact (POCs)

Provide a comprehensive list of POCs needed to implement the FF&E package. This would include but not be limited to appropriate project team members, using activity contacts, interior design representatives, construction contractors and installers involved in the project. In addition to name, address, phone, fax and email, include each contact's job function. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

#### 1.1.6. Color Boards

Provide color boards for all finishes and fabrics for all FF&E items. Finishes to be included but not limited to paint, laminate, wood finish, fabric, etc.

#### 1.1.7. Itemized Furniture Cost Estimate

Provide an itemized cost estimate of furnishings keyed to the plans and specifications of products included in the package. This cost estimate should be based on GSA price schedules. The cost estimate must include separate line items for general contingency, installation, electrical hook-up for systems furniture or other furniture requiring hardwiring by a licensed electrician, freight charges and any other related costs. Installation and freight quotes from vendors should be use in lieu of a percentage allowance when available. Include a written statement that the pricing is based on GSA schedules. An estimate developed by a furniture dealership may be provided as support information for the estimate, but must be separate from the contractor provided estimate.

### 1.2. INTERIOR DESIGN DOCUMENTS

#### 1.2.1. Overall Furniture and Area Plans

Provide floor Plans showing locations and quantities of all freestanding, and workstation furniture proposed for each floor of the building. Key each room to a large scale Furniture Placement Plan showing the furniture configuration, of all furniture. Provide enlarged area plans with a key plan identifying the area in which the building is located. Key all the items on the drawings by furniture item code. Do not provide manufacturer specific information such as product names and numbers on drawings, Drawings shall be non-proprietary. This is typical for FFE on all plans, including those mentioned below.

#### 1.2.2. Workstation Plans

Show each typical workstation configuration in plan view, elevations or isometric view. Drawings shall illustrate panels and all major components for each typical workstation configuration. Identify workstations using the same numbering system as shown on the project drawings. Key components to a legend on each sheet which identifies and describes the components along with dimensions. Provide the plan, elevations and isometric of each typical workstation together on the same drawing sheet.

#### 1.2.3. Panel Plans

Show panel locations and critical dimensions from finished face of walls, columns, panels including clearances and aisle widths. Key panel assemblies to a legend which shall include width, height, configuration of frames, panel fabric and finishes (if there are different selections existing within a project), powered or non-powered panel and wall mount locations.

#### 1.2.4. Desk Plans

Provide typical free standing desk configurations in plan view, elevation or isometric view and identify components to clearly represent each desk configuration.

#### 1.2.5. Reflected Ceiling Plans

Provide typical plans showing ceiling finishes and heights, lighting fixtures, heating ventilation and air conditioning supply and return, and sprinkler head placement for coordination of furniture.

#### 1.2.6. Electrical and Telecommunication Plans

Show power provisions including type and locations of feeder components, activated outlets and other electrical components. Show locations and quantities of outlets for workstations. Clearly identify different outlets, i.e. electrical, LAN and telecommunication receptacles indicating each type proposed. Show wiring configuration, (circuiting, switching, internal and external connections) and provide as applicable.

#### 1.2.7. Artwork Placement Plans

Provide an Artwork Placement Plan to show location of artwork, assign an artwork item code to each piece of artwork. As an alternative, artwork can be located on the Furniture Plans. Provide a schedule that identifies each piece by room name and number. Provide installation instructions; include mounting height.

#### 1.2.8. Window Drapery Plans

Provide Interior Window Drapery Plans. Key each drapery treatment to a schedule showing color, pattern, material, drapery size and type, draw direction, location and quantities.

### 1.3. FURNITURE SELECTION

1.3.1. Select furniture from the GSA Schedules. Specify furniture available open market when an item is not available on the GSA Schedules. Provide justification for items not available on the GSA Schedules.

1.3.2. To the greatest extent possible when specifying furniture work within a manufacturer's family of furniture for selections, example: Steelcase, Turnstone, Brayton International, Metro, and Vecta are all Steelcase companies. Each alternate should also be specified from a manufacturer's family of furniture, example: first set of alternates would be specified from Knoll's family of furniture and the second from Herman Miller family of furniture. It may be necessary to make some selections from other than a manufacturer's family of furniture if costs are not reasonable for particular items, some items are not available or appropriate for the facility or the items are not on GSA Schedule. If this occurs, consider specifying product from an open line that is accessible by numerous dealerships. Select office furniture including case goods, tables, storage, seating, etc. that is compatible in style, finish and color. Select furniture that complies with ANSI/BIFMA and from manufacturer's standard product line as shown in the most recent published price list and/or amendment and not custom product.

### 1.4. CONSTRUCTION

1.4.1. Provide knee space at workstations and tables that is not obstructed by panels/legs that interfere with knee space of seated person and specify modesty panels at walls to be of a height or be hinged to allow access to building wall electrical outlets and communication jacks. Provide desks, storage and tables with leveling devices to compensate for uneven floors.

1.4.2. Specify workstations and storage of steel construction. Provide worksurface tops constructed to prevent warpage. Provide user friendly features such as radius edges. Do not use sharp edges and exposed connections and ensure the underside of desks, tables and worksurfaces are completely and smoothly finished. Provide abutting worksurfaces that mate closely and are of equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface.

1.4.3. Drawers shall stay securely closed when in the closed position and protect wires from damage during drawer operation. Include a safety catch to prevent accidental removal when fully open

1.4.4. Unless otherwise noted, provide lockable desks and workstations, filing cabinets and storage. Key all locks within a one person office the same; key all one person offices within a building differently. If an office or open office area has more than one workstation, key all the workstations differently, but key all locks within an individual workstation the same. Use tempered glass glazing when glazing is required. Use light-emitting diode (LED)/solid state lighting where task lighting is required in furniture.

### 1.5. FINISHES AND UPHOLSTERY

1.5.1. Specify neutral colors for casegoods, furniture systems, storage and tables. Specify desk worksurfaces and table tops that are not too light or too dark in color and have a pattern to help hide soiling. Accent colors are



allowed in break and lounge areas. Keep placement of furniture systems panel fabric accent colors to a minimum. All finishes shall be cleanable with ordinary household cleaning solutions.

1.5.2. Use manufacturer's standard fabrics; including textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Customers Own Material (COM) can be used in headquarter buildings in command suites with executive furniture. Coordinate specific locations with Corps of Engineers Interior Designer.

1.5.3. Specify seating upholstery that meets Wyzenbeek Abrasion Test, 55,000 minimum rubs. Specify a soil retardant finish for woven fabrics if Crypton or vinyl upholstery is not provided for seating in dining areas. Use manufacturer's standard fabrics. This includes textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Specify upholstery and finish colors and patterns that help hide soiling. Specify finishes that can be cleaned with ordinary household cleaning solutions.

## 1.6. ACCESSORIES

1.6.1. Specify all accessories required for completely finished furniture installation. Provide filing cabinets and storage for office supplies. Provide tack surfaces at workstations with overhead storage. Provide tackable surfaces at workstations with overhead storage.

1.6.2. Not Used.

1.6.3. Workstations are to be equipped with stable keyboard trays that have height adjustability, tilting capability, including negative tilt, have a mouse pad at same height as the keyboard tray that can accommodate both left and right handed users, and retractable under worksurface.

## 1.7. MISSION UNIQUE EQUIPMENT

Funding for FF&E furniture items and mission unique equipment (MUE) items are from two different sources. Separate the designs and procurement documentation for FFE items and MUE. MUE includes, but is not limited to, items such as industrial shelving, workbenches, appliances, fitness equipment, IT equipment and supporting carts. The User will purchase and install mission unique equipment items, unless otherwise noted. Identify locations of known MUE items such as industrial shelving, workbenches, appliances, etc. for space planning purposes.

## 1.8. SUSTAINABILITY

1.8.1. For all designs provided regardless of facility type, make every effort to implement all aspects of sustainability to the greatest extent possible for all the selections made in the FF&E package. This includes but is not limited to the selection of products that consider: **Material Chemistry and Safety of Inputs** (What chemicals are used in the construction of the selections?); **Recyclability** (Do the selections contain recycled content?); **Disassembly** (Can the selections be disassembled at the end of their useful life to recycle their materials?).

1.8.2. Make selections to the greatest extent possible of products that possess current McDonough Braungart Design Chemistry ([MBDC](#)) certification or other "third-party" certified Cradle to Cradle program, Forest Stewardship Council (FSC) certification, GREENGAURD certification or similar "third-party" certified products consisting of low-emitting materials.

## 1.9. FURNITURE SYSTEMS

1.9.1. General.

Where appropriate, design furniture systems in open office areas. Coordinate style and color of furniture systems with other storage, seating, etc. in open office areas. Minimize the number of workstation typicals and the parts and pieces required for the design to assist in future reconfiguration and inventorying.

1.9.2. Connector Systems.

Specify a connector system that allows removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels. Specify connector

system with tight connections and continuous visual seals. When Acoustical panels are used, provide connector system with continuous acoustical seals. Specify concealed clips, screws, and other construction elements, where possible.

#### 1.9.3. Panels and Spine Walls

Specify panels and spine walls with hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Panels shall be capable of structurally supporting more than 1 fully loaded component per panel per side. Raceways are to be an integral part of the panel and must be able to support lay-in cabling and have a large capacity for electrical and IT. Do not thread cables through the frame.

#### 1.9.4. Electrical And Information/Technology (IT)

Design furniture with electrical systems that meets requirements of UL 1286 when powered panels are required and UL approved task lights that meet requirements of NFPA 70. Dependent on user requirements and Section 01 10 00, paragraph 3 requirements, it is recommended that workstation electrical and IT wiring entry come from the building walls to eliminate the use of power poles and access at the floor. Design electrical and IT systems that are easily accessed in the spine wall and panels without having to move return panels and components. Electrical and IT management will be easily accessible by removable wall covers which can be removed while workstation components are still attached. Specify connector system that has continuation of electrical and IT wiring within workstations and workstation to workstation.

#### 1.9.5. Pedestals

Specify pedestals that are interchangeable from left to right, and right to left, and retain pedestal locking system capability.

### 1.10. EXECUTIVE FURNITURE

1.10.1. Design for executive furniture in command areas, coordinate specific locations with Corps of Engineers Interior Designer. Use upgraded furniture, upholsteries and finishes in command suites. This includes but is not limited to wood casegoods, seating and tables. Select executive furniture casegoods from a single manufacturer and style line, to include workstations, credenzas, filing, and storage, etc.

1.10.2. Specify furniture with wood veneer finish (except worksurfaces) with mitered solid wood edge of same wood type. Provide worksurface plastic laminate that closely matches adjacent wood veneer. Other executive office furniture such as seating, tables, executive conference room furniture, etc. shall be compatible in style, finish and color with executive furniture casegoods.

### 1.11. SEATING

#### 1.11.1. General

Specify appropriate chair casters and glides for the floor finish where the seating is located. Universal casters that are appropriate for both hard surface flooring and carpet are preferred. All seating shall support up to a minimum of 250 lbs.

#### 1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, non-upholstered adjustable arms, waterfall front, swivel, tilt, variable back lock, adjustable back height or adjustable lumbar support, pneumatic seat height adjustment, and padded, contoured upholstered seat and back. Desk and guest chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Depending on scale of desk chair provide seat pan forward and back adjustment to increase or decrease depth of seat pan. All desk chairs shall have an adjustable seat height range of 4 1/2", range to include 16 1/2"-20". Select guest chairs that are compatible in style, finish and color with the desk chairs.

#### 1.11.3. Conference Room Seating

At tables, select ergonomic conference seating with casters, non-upholstered arms, waterfall front, swivel, tilt, pneumatic seat height adjustment, and padded, contoured seat and back, unless otherwise noted. Select arm height and/or design that allows seating to be moved up closely to the table top. Conference chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Perimeter conference chairs shall be compatible in style, finish and color with conference seating at the tables.

#### 1.11.4. Lounge, Waiting and Reception Area Seating

Select seating with arms and cushioned, upholstered seat and back. In heavy use areas, arms shall be easily cleaned such as non-upholstered arms or upholstered arms with wood arm caps unless otherwise noted.

#### 1.11.5. Break Room Seating

Select stackable seating that is easily cleaned. Seating shall be appropriate for table and counter heights as applicable with non-upholstered arms if arms are required. Chairs shall have metal legs and composite materials for seats.

#### 1.11.6. Lounge, Waiting and Reception Furniture.

Design for end and coffee tables with plastic laminate tops that are compatible in style finish and color with the seating.

#### 1.12. FILING AND STORAGE.

Select storage and shelving units that meet customer's functional load requirements for stored items. Specify counterweights for filing cabinets when required by the manufacturer for stability. File drawers shall allow only one drawer to be opened at a time. Provide heavy duty storage and shelving if information is not available.

#### 1.13. TRAINING TABLES.

Don't use plastic laminate self edge. Training tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or casters as necessary. Specify dollies if required.

#### 1.14. FURNITURE WARRANTIES.

Specify manufacturer's performance guarantees or warranties that include parts, labor and transportation as follows:

Furniture System, unless otherwise noted – 10 year minimum  
 Furniture System Task Lights – 2 year minimum, excluding bulbs  
 Furniture System Fabric – 3 year minimum  
 Desks - 10 year minimum  
 Seating, unless otherwise noted - 10 year minimum  
 Seating Mechanisms and Pneumatic Cylinders - 10 years  
 Fabric - 3 years minimum  
 Filing and Storage - 10 year minimum  
 Tables, unless otherwise noted - 10 year minimum  
 Table Mechanisms – 5 year  
 Table Ganging Device - 1 year  
 Items not listed above - 1 year minimum

## **ATTACHMENT C**

### **TRACKING COMMENTS IN DRCHECKS**

#### **1.0 General**

The Government and DB Contractor shall set up the project in Dr Checks. Throughout the design process, the parties shall enter, track, and back-check comments using the DrChecks system. Government reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate exactly what action will be taken or why the action is not required. Comments considered critical by the conference participants shall be flagged as such.

#### **2.0 DrChecks Review Comments**

The Contractor and the Government shall monitor DrChecks to assure all comments are annotated and agreed to by the designers and reviewers prior to the next submittal. The DrChecks comments and responses shall be printed and included in the design analysis for record.

2.1. Conference participants (reviewers) will expect coordination between Design Analysis calculations and the submitted design. Reviewers will also focus on the design submittal's satisfaction of the contract requirements.

2.2. The Designers of Record shall answer each comment in DrChecks with a formal response prior to the next submittal, clearly indicating what action will be taken and what drawing/spec will change. Designers of Record are encouraged to directly contact reviewers to discuss and agree to the formal comment responses rather than relying only on DrChecks and review meetings to discuss comments. With the next design conference, reviewers will back-check answers to the comments against the submittal, in addition to reviewing additional design work.

2.3. Comments that, in the DB Contractor's opinion, require effort outside the scope of the contract shall be clearly indicated as such in DrChecks. The DB Contractor shall not proceed with work outside the contract until a modification to the contract is properly executed, if one is necessary.

#### **3.0 DrChecks Initial Account Set-Up**

To initialize an office's use of DrChecks, choose a contact person within the office to call the DrChecks Help Desk at 800-428-HELP, M-F, 8AM-5PM, Central time. This POC will be given an office password to distribute to others in the office. Individuals can then go to the hyperlink at <http://www.projnet.org> and register as a first time user. Upon registration, each user will be given a personal password to the DrChecks system.

3.1. Once the office and individuals are registered, the COE's project manager or lead reviewer will assign the individuals and/or offices to the specific project for review. At this point, persons assigned can make comments, annotate comments, and close comments, depending on their particular assignment.

#### **4.0 DrChecks Reviewer Role**

The Contractor is the technical reviewer and the Government is the compliance reviewer of the DB designers design documents. Each reviewer enters their own comments into the Dr Checks system. To enter comments:

4.1. Log into DrChecks.

4.2. Click on the appropriate project.

4.3. Click on the appropriate review conference. An Add comment screen will appear.

4.4. Select or fill out the appropriate sections (particularly comment discipline and type of document for sorting) of the comment form and enter the comment in the space provided.

4.5. Click the Add Comment button. The comment will be added to the database and a fresh screen will appear for the next comment you have.

4.6. Once comments are all entered, exit DrChecks by choosing “My Account” and then Logout.

## **5.0 DrChecks Comment Evaluation**

The role of the designers of record is to evaluate and respond to the comments entered by the Government reviewers and by the DB Contractor. To respond to comments:

5.1. Log into DrChecks.

5.2. Click on the appropriate project.

5.3. Under “Evaluate” click on the number under “Pending”.

5.4. Locate the comments that require your evaluation. (Note: If you know the comment number you can use the Quick Pick window on your home page in DrChecks; enter the number and click on go.)

5.5. Select the appropriate evaluation (concur, non-concur, for information only, or check and resolve) and add the response.

5.6. Click on the Add button. The evaluation will be added to the database and a fresh screen will appear with the next comment.

5.7. Once evaluations are all entered, exit DrChecks by choosing “My Account” and then Logout.

## **6.0 DrChecks Back-check**

At the following design conference, participants will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and completed. The Contractor and Government reviewers shall either enter additional back-check comments, as necessary or close those that are resolved as a result of the design conferences:

6.1. Log into DrChecks.

6.2. Click on the appropriate project.

6.3. Under “My Backcheck” click on the number under “Pending”.

6.4. If you agree with the designer's response select “Close Comment” and add a closing response if desired.

6.5. If you do not agree with the designer's response or the submittal does not reflect the response given, select “Issue Open”, enter additional information.

6.6. Click on the Add button. The back-check will be added to the database and a fresh screen will appear with the next comment.

6.7. Once back-checks are all entered, exit DrChecks by choosing “My Account” and then Logout. The design is completed and final when there are no pending comments to be evaluated and there are no pending or open comments under back-check.

**ATTACHMENT D**  
**SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

Instructions: Use the information outlined in this document to provide the minimum requirement for development of Fire Protection and Life Safety Code submittals for all building projects. Additional and supplemental information may be used to further develop the code review. Insert N/A after criteria, which may be "not applicable".

**1.0 SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW**

- 1.1. Project Name (insert name and location)
- 1.2. Applicable Codes and Standards
  - 1.2.1. Unified Facilities Criteria (UFC): 3-600-01, Design: Fire Protection Engineering For Facilities
  - 1.2.2. International Building Code (IBC) for fire resistance requirements, allowable floor area, building height limitations and building separation distance requirements, except as modified by UFC 3-600-01.
  - 1.2.3. National Fire Protection Association (NFPA) 101 Life Safety Code (latest edition), for building egress and life safety and applicable criteria in UFC 3-600-01.
  - 1.2.4. ADA and ABA Accessibility Guidelines. For Buildings and Facilities See Section 01 10 00, Paragraph 3 for facility specific criteria.
- 1.3. Occupancy Classification  
IBC chapters 3 and 4
- 1.4. Construction Type  
IBC chapter 6
- 1.5. Area Limitations  
IBC chapter 5, table 503
- 1.6. Allowable Floor Areas  
IBC section 503, 505
- 1.7. Allowable area increases  
IBC section 506, 507
- 1.8. Maximum Height of Buildings  
IBC section 504
- 1.9. Fire-resistive substitution
- 1.10. Occupancy Separations  
IBC table 302.3.2
- 1.11. Fire Resistive Requirements
  - 1.11.1. Exterior Walls - [ ] hour rating, IBC table 601, 602
  - 1.11.2. Interior Bearing walls - [ ] hour rating
  - 1.11.3. Structural frame - [ ] hour rating
  - 1.11.4. Permanent partitions - [ ] hour rating

- 1.11.5. Shaft enclosures - [ ] hour rating
- 1.11.6. Floors & Floor-Ceilings - [ ] hour rating
- 1.11.7. Roofs and Roof Ceilings - [ ] hour rating
- 1.12. Automatic Sprinklers and others used to determine the need for automatic Extinguishing Equipment, Extinguishing Systems, Foam Systems, Standpipe
  - 1.12.1. UFC 3-600-01, chapters 4 and 6 systems, wet chemical systems, etc. State which systems are required and to what criteria they will be designed.
  - 1.12.2. UFC 3-600-01, Appendix B Occupancy Classification. Note the classification for each room. This may be accomplished by classifying the entire building and noting exceptions for rooms that differ (E.g. The entire building is Light Hazard except boiler room and storage rooms which are [ ], etc.)
  - 1.12.3. UFC 3-600-01, Chapter 3 Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams (supply pressure and source requirements).
  - 1.12.4. UFC 3-600-01, Chapter 4 Coverage per sprinkler head. Extended coverage sprinkler heads are not permitted.
  - 1.12.5. Available Water Supply. Provide the results of the water flow tests showing the available water supply static pressure and residual pressure at flow. Based on this data and the estimated flow and pressure required for the sprinkler system, determine the need for a fire pump.
  - 1.12.6. NFPA 13, Para. 8.16.4.6.1. Provide backflow preventer valves as required by the local municipality, authority, or water purveyor. Provide a test valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building.
- 1.13. Kitchen Cooking Exhaust Equipment

Describe when kitchen cooking exhaust equipment is provided for the project. Type of extinguishing systems for the equipment should be provided. per NFPA 96. Show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms.
- 1.14. Portable Fire Extinguishers, fire classification and travel distance. per NFPA 10
- 1.15. Enclosure Protection and Penetration Requirements. - Opening Protectives and Through Penetrations
  - 1.15.1. IBC Section 712, 715 and Table 715.3. Mechanical rooms, exit stairways, storage rooms, janitor [ ] hour rating. IBC Table 302.1.1
  - 1.15.2. Fire Blocks, Draft Stops, Through Penetrations and Opening Protectives
- 1.16. Fire Dampers. Describe where fire dampers and smoke dampers are to be used (IBC Section 716 and NFPA 90A). State whether isolation smoke dampers are required at the air handler.
- 1.17. Detection Alarm and Communication. UFC 3-600-01, (Chapter 5); NFPA 101 para. 3.4 (chapters 12-42); NFPA 72
- 1.18. Mass Notification. Describe building/facility mass notification system (UFC 4-021-01) type and type of base-wide mass notification/communication system. State whether the visible notification appliances will be combined with the fire alarm system or kept separate. (Note: Navy has taken position to combine visible notification appliances with fire alarm).
- 1.19. Interior Finishes (classification). NFPA 101.10.2.3 and NFPA 101.7.1.4
- 1.20. Means of Egress

- 1.20.1. Separation of Means of Egress, NFPA 101 chapters 7 and 12-42; NFPA101.7.1.3
- 1.20.2. Occupant Load, NFPA101.7.3.1 and chapters 12-42.
- 1.20.3. Egress Capacity (stairs, corridors, ramps and doors) NFPA101.7.3.3
- 1.20.4. Number of Means of Egress, NFPA101.7.4 and chapters 12-42.
- 1.20.5. Dead end limits and Common Path of Travel, NFPA 101.7.5.1.6 and chapters 12-42.
- 1.20.6. Accessible Means of Egress (for accessible buildings), NFPA101.7.5.4
- 1.20.7. Measurement of Travel Distance to Exits, NFPA101.7.6 and chapters 12-42.
- 1.20.8. Discharge from Exits, NFPA101.7.7.2
- 1.20.9. Illumination of Means of Egress, NFPA101.7.8
- 1.20.10. Emergency Lighting, NFPA101.7.9
- 1.20.11. Marking of Means of Egress, NFPA101.7.10
- 1.21. Elevators, UFC 3-600-01, Chapter 6; IBC and ASME A17.1 - 2000,(Safety Code for Elevators and Escalators)
- 1.22. Accessibility Requirements, ADA and ABA Accessibility Guidelines for Buildings and Facilities
- 1.23. Certification of Fire Protection and Life Safety Code Requirements. (Note: Edit the Fire team membership if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project in accordance with the attached completed form(s).
- 1.24. Designer of Record. Certification of Fire protection and Life Safety Code Requirements. (Note: Edit the Fire team members if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features of this project.

Fire Protection Engineer of Record:

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Signature and Stamp

Date

OR

Architect of Record:

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Signature and Stamp

Date

Mechanical Engineer of Record:

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Signature and Stamp

Date

Electrical Engineer of Record:

Friday, February 18, 2011



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Signature/Date

**ATTACHMENT E**  
**LEED SUBMITTALS**

| LEED Credit Paragraph                 | Contractor Check Here if Credit is Claimed | LEED-NC v2.2 Submittals (OCT09REV)  | Provide for Credit Audit Only |   | Date Submitted (to be filled in by Contractor) | Government Reviewer's Use (OCT09REV) |
|---------------------------------------|--|---|-------------------------------|---|--|--------------------------------------|
| PAR                                   |  | FEATURE   | DUE AT                        | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
| <b>GENERAL</b>                        |  |   |                               |   |  |                                      |
|                                       |  | GENERAL - All calculations shall be in accordance with LEED 2.2 Reference Guide.  |                               |   |  |                                      |
|                                       |  | GENERAL: Obtain excel version of this spreadsheet at <a href="http://en.sas.usace.army.mil/enWeb/EngineeringCriteria">http://en.sas.usace.army.mil/enWeb/EngineeringCriteria</a> . OCT09REV |                               |   |  |                                      |
|                                       |  | GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.                                     |                               |   |  |                                      |
|                                       |  | GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings, labeled For Reference Only.  |                               |   |  |                                      |
|                                       |  | NOTE: Each submittal indicated with "****" differs from LEED certified project submittals by either having a different due date or being an added submittal not required by GBCI. OCT09REV  |                               |   |  |                                      |
|                                       |  | OCT09REV GENERAL - Audit documentation may include but is not limited to what is indicated in this table.   |                               |   |  |                                      |
|                                       |  |   | Closeout                      | List of all Final Design submittals revised after final design to reflect actual closeout conditions. Revised Final Design submittals. - OR - Statement confirming that no changes have been made since final design that effect final design submittal documents.  |  | Proj Engr (PE)                       |
| <b>CATEGORY 1 - SUSTAINABLE SITES</b> |  |   |                               |   |  |                                      |
| SSPR1                                 |  | Construction Activity Pollution Prevention (PREREQUISITE)   | **Final Design                | List of drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented.  |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                       |  |   | **Final Design                | Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program. |  | CIV                                  |
| SS1                                   |  | Site Selection  | Final Design                  | Statement confirming that project does not meet any of the prohibited criteria.   |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                       |  |   | Final Design                  | LEED Site plan drawing that shows all proposed development, line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary and a line depicting 5' elevation above 100 year flood line that falls within project boundary. Not required if neither condition applies.   |  | CIV                                  |
| SS2                                   |  | Development Density & Community Connectivity  | Final Design                  | Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.  |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.                        |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.   |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 2: List (including business name and type) of all Basic Services facilities within the 1/2 mile radius, keyed to site vicinity plan.   |  | CIV                                  |
| SS3                                   |  | Brownfield Redevelopment  | Final Design                  | Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.   |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
| SS4.1                                 |  | Alternative Transportation: Public Transportation Access  | Final Design                  | Statement indicating which option for compliance applies. State whether public transportation is existing or proposed and, if proposed, cite source of this information.  |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.  |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.   |  | CIV                                  |
| SS4.2                                 |  | Alternative Transportation: Bicycle Storage & Changing Rooms  | Final Design                  | FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.  |  | CIV                                  |
|                                       |  |   | Final Design                  | List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.  |  | CIV                                  |
|                                       |  |   | Final Design                  | List of drawings that show the location(s) of shower/changing facilities and, if located outside the building, statement indicating distance from building entrance.  |  | ARC                                  |
| SS4.3                                 |  | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles  | Final Design                  | Statement indicating which option for compliance applies. FTE calculation. Statement indicating total parking capacity of site.   |  | CIV                                  |
| OCT09REV                              |  |   | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                       |  |   | Final Design                  | Option 1: Low-emission & fuel-efficient vehicle calculation.  |  | CIV                                  |

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| PAR                   |  | FEATURE                                      | DUE AT                        | REQUIRED DOCUMENTATION   | DATE   | REV                                  |
|                       |  |  | Final Design                  | Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.  |  | CIV                                  |
|                       |  |  | Final Design                  | Option 1: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.  |  | CIV                                  |
|                       |  |  | Final Design                  | Option 2: Low-emission & fuel-efficient vehicle parking calculation.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 3: Low-emission & fuel-efficient vehicle refueling station calculation.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 3: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.  |  | CIV                                  |
|                       |  |  | Closeout                      | Option 3: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.   |  | CIV                                  |
| SS4.4                 |  | Alternative Transportation: Parking Capacity | Final Design                  | Statement indicating which option for compliance applies.  |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.  |  | CIV                                  |
|                       |  |  | Final Design                  | Options 1 and 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.  |  | CIV                                  |
|                       |  |  | Final Design                  | Option 3: Narrative indicating number of spaces required and provided and describing infrastructure and support programs with description of project features to support them.   |  | CIV                                  |
| SS5.1                 |  | Site Development: Protect or Restore Habitat | **Final Design                | Option 1: List of drawing and specification references that convey site disturbance limits.  |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
|                       |  |  | **Final Design                | Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each.   |  | CIV                                  |
|                       |  |  | **Final Design                | Option 2: Percentage calculation of restored/preserved habitat to total site area. List of drawings and specification references that convey restoration planting requirements.  |  | CIV                                  |
| SS5.2                 |  | Site Development: Maximize Open Space        | Final Design                  | Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted.   |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
| SS6.1                 |  | Stormwater Design: Quantity Control          | Final Design                  | Statement indicating which option for compliance applies.  |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
|                       |  |  | Final Design                  | Option 1: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.                                      |  | CIV                                  |
|                       |  |  | Final Design                  | Option 2: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.   |  | CIV                                  |
| SS6.2                 |  | Stormwater Design: Quality Control           | Final Design                  | For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated. |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
| SS7.1                 |  | Heat Island Effect: Non-Roof                 | **Final Design                | LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.  |  | CIV                                  |
| OCT09REV              |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.   |  | CIV                                  |
| SS7.2                 |  | Heat Island Effect: Roof                     | Final Design                  | Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.   |  | ARC                                  |

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| PAR                                  |  | FEATURE  | DUE AT                        | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
|                                      |  |  | Final Design<br>OCT09REV      | Option 1: List of specified roof materials indicating, for each, product type, manufacturer, product name and identification if known, SRI value and roof slope.<br>OCT09REV  |  | ARC                                  |
|                                      |  |  | **Closeout<br>OCT09REV        | Option 1: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.   |  | PE                                   |
|                                      |  |  | Closeout                      | X Option 1: Manufacturer published product data or certification confirming SRI   |  | PE                                   |
|                                      |  |  | Final Design                  | Option 2: Percentage calculation indicating percentage of vegetated roof area.  |  | ARC                                  |
|                                      |  |  | Final Design                  | Option 3: Combined reflective and green roof calculation.   |  | ARC                                  |
|                                      |  |  | Final Design<br>OCT09REV      | Option 3: List of specified roof materials indicating, for each, product type, manufacturer, product name and identification if known, SRI value and roof slope.<br>OCT09REV  |  |                                      |
|                                      |  |  | **Closeout<br>OCT09REV        | Option 3: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.   |  | PE                                   |
|                                      |  |  | Closeout                      | X Option 3: Manufacturer published product data or certification confirming SRI   |  | PE                                   |
| SS8                                  |  | Light Pollution Reduction  | Final Design                  | Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interior fixtures does not intersect non-opaque building envelope surfaces).<br>- OR - List of drawings and specification references that show automatic lighting controls that turn off non-essential lighting during non-business hours |  | ELEC                                 |
| OCT09REV                             |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building facade/landscape lighting).  |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.   |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.  |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.   |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.  |  | ELEC                                 |
|                                      |  |  | Final Design                  | Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.  |  | ELEC                                 |
| <b>CATEGORY 2 – WATER EFFICIENCY</b> |  |  |                               |   |  |                                      |
| WE1.1                                |  | Water Efficient Landscaping: Reduce by 50%                         | Final Design                  | Statement indicating which option for compliance applies.   |  | CIV                                  |
| OCT09REV                             |  |  | **Final Design                | Delineation and labeling of "LEED Project site boundary" on site plan.  |  | CIV                                  |
|                                      |  |  | Final Design                  | Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.   |  | CIV                                  |
|                                      |  |  | Final Design                  | List of landscape plan drawings.  |  | CIV                                  |
|                                      |  |  | Final Design                  | Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.   |  | CIV                                  |
| WE1.2                                |  | Water Efficient Landscaping: No Potable Water Use or No Irrigation | Same as WE1.1                 | Same as WE1.1   |  | CIV                                  |
| WE2                                  |  | Innovative Wastewater Technologies                                 | Final Design                  | Statement confirming which option for compliance applies.   |  | MEC                                  |

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| PAR                                       |  | FEATURE   | DUE AT                        | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
|   |  |   | Final Design                  | Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.  |  | MEC                                  |
|   |  |   | Final Design                  | Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users   |  | MEC                                  |
|   |  |   | Final Design                  | Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.   |  | MEC                                  |
|   |  |   | Final Design                  | Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.   |  | MEC                                  |
|   |  |   | Final Design                  | Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.   |  | MEC                                  |
|   |  |   | Final Design                  | Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.  |  | MEC                                  |
|   |  |   | Final Design                  | Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.   |  | MEC                                  |
|   |  |   | Final Design                  | Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site.  |  | MEC                                  |
|   |  |   | Final Design                  | Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.   |  | CIV                                  |
|   |  |   | Final Design                  | Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources. |  | CIV                                  |
|   |  |   | Final Design                  | Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage conveyance reduction.  |  | MEC                                  |
|   |  |   | Final Design                  | Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.   |  | MEC                                  |
| WE3.1                                     |  | Water Use Reduction: 20% Reduction                                      | Final Design                  | Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.  |  | MEC                                  |
|   |  |   | Final Design                  | Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users   |  | MEC                                  |
|   |  |   | Final Design                  | Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.   |  | MEC                                  |
|   |  |   | Final Design                  | Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.   |  | MEC                                  |
|   |  |   | Final Design                  | Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.   |  | MEC                                  |
|   |  |   | Closeout                      | X Manufacturer published product data or certification confirming fixture water usage.  |  | PE                                   |
| WE3.2                                     |  | Water Use Reduction: 30% Reduction                                      | Same as WE3.1                 | Same as WE3.1   |  | MEC                                  |
| <b>CATEGORY 3 – ENERGY AND ATMOSPHERE</b> |  |   |                               |   |  |                                      |
| EAPR1                                     |  | Fundamental Commissioning of the Building Energy Systems (PREREQUISITE) | **Final Design                | **Owner's Project Requirements document   |  | ALL                                  |
|   |  |   | **Final Design                | **Basis of Design document for commissioned systems   |  | MEC, ELEC                            |
|   |  |   | **Final Design                | **Commissioning Plan  |  | MEC, ELEC                            |

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| PAR                   |  | FEATURE   | DUE AT                        | REQUIRED DOCUMENTATION   | DATE   | REV                                  |
|                       |  |   | Closeout                      | Statement confirming all commissioning requirements have been incorporated into construction documents.  |  | PE                                   |
|                       |  |   | Closeout                      | Commissioning Report   |  | PE                                   |
| EAPR2                 |  | Minimum Energy Performance (PREREQUISITE)         | Final Design                  | Statement listing the mandatory provisions of ASHRAE 90.1 that project meets relative to compliance with this prerequisite and indicating which compliance path was used.  |  | MEC<br>ELEC<br>ARC                   |
| EAPR3                 |  | Fundamental Refrigerant Management (PREREQUISITE) | Final Design                  | Statement indicating which option for compliance applies.  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 2: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities.   |  | MEC                                  |
| EA1                   |  | Optimize Energy Performance                       | Final Design                  | Statement indicating which compliance path option applies.   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Energy type summary listing, for each energy type, utility rate description, units of energy and units of demand   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.   |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.  |  | MEC                                  |
|                       |  |   | Final Design                  | Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost. |  | MEC                                  |

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| PAR                   |  | FEATURE                            | DUE AT                        | REQUIRED DOCUMENTATION   | DATE   | REV                                  |
|                       |  |                                    | Final Design                  | Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features |  | MEC                                  |
|                       |  |                                    | Final Design                  | Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)  |  | MEC                                  |
| EA2.1                 |  | On-Site Renewable Energy           | Final Design                  | Statement indicating which compliance path option applies.   |  | ELEC                                 |
|                       |  |                                    | Final Design                  | List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.  |  | ELEC<br>MEC                          |
|                       |  |                                    | Final Design                  | Option 1: Indicate, for renewable energy, proposed design total annual energy generated and annual cost.   |  | ELEC<br>MEC                          |
|                       |  |                                    | Final Design                  | Option 2: Indicate CBECS building type and building gross area. Provide the following CBECS data: median annual electrical intensity, median annual non-electrical fuel intensity, average electric energy cost, average non-electric fuel cost, annual electric energy use and cost, annual non-electric fuel use and cost.   |  | ELEC<br>MEC                          |
|                       |  |                                    | Final Design                  | Option 2: Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.  |  | ELEC<br>MEC                          |
| EA2.2                 |  | On-Site Renewable Energy           | Same as EA2.1                 | Same as EA2.1  |  | ELEC<br>MEC                          |
| EA2.3                 |  | On-Site Renewable Energy           | Same as EA2.1                 | Same as EA2.1  |  | ELEC<br>MEC                          |
| EA3                   |  | Enhanced Commissioning             | **Final Design                | **Owner's Project Requirements document (OPR)  |  | ALL                                  |
|                       |  |                                    | **Final Design                | **Basis of Design document for commissioned systems (BOD)  |  | ELEC<br>MEC                          |
|                       |  |                                    | **Final Design                | **Commissioning Plan   |  | ELEC<br>MEC                          |
|                       |  |                                    | Closeout                      | Statement confirming all commissioning requirements have been incorporated into construction documents.  |  | PE                                   |
|                       |  |                                    | Closeout                      | **Commissioning Report   |  | PE                                   |
|                       |  |                                    | **Final Design                | Statement by CxA confirming Commissioning Design Review  |  |                                      |
|                       |  |                                    | Closeout                      | Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD  |  | PE                                   |
|                       |  |                                    | Closeout                      | **Systems Manual   |  | PE                                   |
|                       |  |                                    | Closeout                      | Statement by CxA confirming completion of O&M staff and occupant training  |  | PE                                   |
|                       |  |                                    | Closeout                      | **Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues   |  | PE                                   |
|                       |  |                                    | **Predesign                   | Statement confirming CxA qualifications and contractual relationships relative to work on this project, demonstrating that CxA is an independent third party.  |  | MEC                                  |
| EA4                   |  | Enhanced Refrigerant Management    | Final Design                  | Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2.2 Reference Guide Example Calculations   |  | MEC                                  |
|                       |  |                                    | Final Design                  | Narrative describing any special circumstances or explanatory remarks OCT09REV   |  |                                      |
|                       |  |                                    | Closeout                      | X Cut sheets highlighting refrigerant data for all HVAC components.  |  | PE                                   |
| EA5                   |  | Measurement & Verification         | Closeout                      | Statement indicating which compliance path option applies.   |  | PE                                   |
|                       |  |                                    | Closeout                      | Measurement and Verification Plan  |  | PE                                   |
|                       |  |                                    | Closeout                      | **Scope of work for post-occupancy implementation of M&V plan  |  | PE                                   |
| EA6                   |  | Green Power                        | Closeout                      | Statement indicating which compliance path option applies.   |  | PE                                   |
|                       |  |                                    | Closeout                      | Option 1: Indicate proposed design total annual electric energy usage  |  | PE                                   |
|                       |  |                                    | Closeout                      | Option 2: Indicate actual total annual electric energy usage   |  | PE                                   |
|                       |  |                                    | Closeout                      | Option 3: Calculation indicating building type, total gross area, median electrical intensity and annual electric energy use   |  | PE                                   |

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|---|--|--|---------------------------------------|---|--|--------------------------------------|
| PAR   |  | FEATURE  | DUE AT                                | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
|   |  |  | Closeout                              | Green power provider summary table indicating, for each purchase type, provider name, annual quantity green power purchased and contract term. Indicate total annual green power use and indicate percent green power   |  | PE                                   |
|   |  |  | Closeout                              | Narrative describing how Green Power or Green Tags are purchased  |  | PE                                   |
| <b>CATEGORY 4 – MATERIALS AND RESOURCES</b> |  |  |                                       |   |  |                                      |
| MRPR1                                       |  | Storage & Collection of Recyclables (PREREQUISITE)                     | Final Design                          | Statement confirming that recycling area will accommodate recycling of plastic, metal, paper, cardboard and glass. Narrative indicating any other materials addressed and coordination with pickup.   |  | ARC                                  |
| MR1.1                                       |  | Building Reuse: Maintain 75% of Existing Walls, Floors & Roof          | **Final Design                        | If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.   |  | ARC                                  |
|   |  |  | **Final Design                        | Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.  |  | ARC                                  |
| MR1.2                                       |  | Building Reuse: Maintain 95% of Existing Walls, Floors & Roof          | Same as MR1.1                         | Same as MR1.1   |  | ARC                                  |
| MR1.3                                       |  | Building Reuse: Maintain 50% of Interior Non-Structural Elements       | **Final Design                        | If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.   |  | ARC                                  |
|   |  |  | **Final Design                        | Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.  |  | ARC                                  |
| MR2.1                                       |  | Construction Waste Management: Divert 50% From Disposal                | **Preconstruction                     | Waste Management Plan   |  | PE                                   |
|   |  |  | **Construction Quarterly and Closeout | Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage  |  | PE                                   |
|   |  |  |                                       | OCT09REV  |  |                                      |
|   |  |  | **Construction Quarterly and Closeout | Receipts/tickets for all items on spreadsheet   |  | PE                                   |
| MR2.2                                       |  | Construction Waste Management: Divert 75% From Disposal                | Same as MR2.1                         | Same as MR2.1   |  | PE                                   |
| MR3.1                                       |  | Materials Reuse: 5%  | Closeout                              | Statement indicating total materials value and whether default or actual.   |  | PE                                   |
|   |  |  | Closeout                              | Spreadsheet calculations indicating, for each reused/salvaged material, material description, source or vendor, cost. Total reused/salvaged materials percentage.   |  | PE                                   |
| MR3.2                                       |  | Materials Reuse: 10%   | Same as MR3.1                         | Same as MR3.1   |  | PE                                   |
| MR4.1                                       |  | Recycled Content: 10% (post-consumer + 1/2 pre-consumer)               | Closeout                              | Statement indicating total materials value and whether default or actual.   |  | PE                                   |
|   |  |  | Closeout                              | Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage. |  | PE                                   |
|   |  |  | Final Design or NLT Preconstruction   | **Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV  |  | PE                                   |
|   |  |  | Closeout                              | X Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet  |  | PE                                   |
| MR4.2                                       |  | Recycled Content: 20% (post-consumer + 1/2 pre-consumer)               | Same as MR4.1                         | Same as MR4.1   |  | PE                                   |
| MR5.1                                       |  | Regional Materials: 10% Extracted, Processed & Manufactured Regionally | Closeout                              | Statement indicating total materials value and whether default or actual.   |  | PE                                   |
|   |  |  | Closeout                              | Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, source of manufacture and harvest location data. Total regional materials cost, regional materials percentage.   |  | PE                                   |
|   |  |  | Preconstruction OCT09REV              | **Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV  |  | PE                                   |
|   |  |  | Closeout                              | X Manufacturer published product data or certification confirming regional material percentages in spreadsheet  |  | PE                                   |

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| PAR  |  | FEATURE   | DUE AT                              | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
| MR5.2  |  | Regional Materials:20% Extracted, Processed & Manufactured Regionally | Same as MR5.1                       | Same as MR5.1   |  | PE                                   |
| MR6  |  | Rapidly Renewable Materials   | Closeout                            | Statement indicating total materials value and whether default or actual.   |  | PE                                   |
|  |  |   | Closeout                            | Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.                         |  | PE                                   |
|  |  |   | Final Design OCT09REV               | **Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV  |  | ARC                                  |
|  |  |   | Closeout                            | Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet   |  | PE                                   |
| MR7  |  | Certified Wood  | Closeout                            | Statement indicating total materials value and whether default or actual.   |  | PE                                   |
|  |  |   | Closeout                            | Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage. |  | PE                                   |
|  |  |   | Final Design or NLT Preconstruction | **Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV  |  | PE                                   |
|  |  |   | Closeout                            | Vendor invoices, FSC chain of custody certificates and manufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.   |  | PE                                   |
| <b>CATEGORY 5 – INDOOR ENVIRONMENTAL QUALITY</b> |  |   |                                     |   |  |                                      |
| EQPR1  |  | Minimum IAQ Performance (PREREQUISITE)                                | Final Design                        | Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.   |  | MEC                                  |
|  |  |   | Final Design                        | Narrative describing the project's ventilation design, including specifics about fresh air intake volumes and special considerations.   |  | MEC                                  |
| EQPR2  |  | Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)              | Final Design                        | Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.   |  | ARC                                  |
|  |  |   | Final Design                        | List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).  |  | ARC                                  |
| EQ1  |  | Outdoor Air Delivery Monitoring                                       | Final Design                        | Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.   |  | MEC                                  |
|  |  |   | Final Design                        | List of drawing and specification references that convey conformance to applicable requirements.  |  | MEC                                  |
|  |  |   | Final Design                        | Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.  |  | MEC                                  |
|  |  |   | Closeout                            | Cut sheets for CO2 monitoring system.   |  | PE                                   |
| EQ2  |  | Increased Ventilation   | Final Design                        | Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.   |  | MEC                                  |
|  |  |   | Final Design                        | Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.  |  | MEC                                  |
|  |  |   | Final Design                        | Option 2: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.   |  | MEC                                  |
|  |  |   | Final Design                        | List of drawing and specification references that convey conformance to applicable requirements.  |  | MEC                                  |
| EQ3.1  |  | Construction IAQ Management Plan: During Construction                 | **Preconstruction                   | Construction IAQ Management Plan  |  | PE                                   |
|  |  |   | Closeout                            | Statement confirming whether air handling units were operated during construction   |  | PE                                   |
|  |  |   | Closeout                            | Dated jobsite photos showing examples of IAQ management plan practices being implemented. Label photos to indicate which practice they demonstrate. Minimum one photo of each practice at each building.  |  | PE                                   |
|  |  |   | Closeout                            | Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy.  |  | PE                                   |
| EQ3.2  |  | Construction IAQ Management Plan: Before Occupancy                    | **Preconstruction                   | Construction IAQ Management Plan  |  | PE                                   |

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| PAR                   |  | FEATURE   | DUE AT                        | REQUIRED DOCUMENTATION  | DATE   | REV                                  |
|                       |  |   | Closeout                      | Statement indicating which option for compliance applies and confirming that required activities have occurred that meet the applicable requirements.   |  | PE                                   |
|                       |  |   | Closeout                      | Option 1a: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.  |  | PE                                   |
|                       |  |   | Closeout                      | Option 1b: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.   |  | PE                                   |
|                       |  |   | Closeout                      | Option 2: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).  |  | PE                                   |
|                       |  |   | Closeout                      | Option 2: IAQ testing report demonstrating compliance.  |  | PE                                   |
| EQ4.1                 |  | Low Emitting Materials: Adhesives & Sealants                | Closeout                      | Spreadsheet indicating, for each applicable indoor adhesive, sealant and sealant primer used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.   |  | PE                                   |
|                       |  |   | Closeout                      | Spreadsheet indicating, for each applicable indoor aerosol adhesive, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor aerosol adhesives were used for the project.  |  | PE                                   |
|                       |  |   | Closeout                      | X Manufacturer published product data or certification confirming material VOCs in spreadsheet  |  | PE                                   |
| EQ4.2                 |  | Low Emitting Materials: Paints & Coatings                   | Closeout                      | Spreadsheet indicating, for each applicable indoor paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.  |  | PE                                   |
|                       |  |   | Closeout                      | Spreadsheet indicating, for each applicable indoor anti-corrosive/anti-rust paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor anti-corrosive/anti-rust paints were used for the project .  |  | PE                                   |
|                       |  |   | Closeout                      | X Manufacturer published product data or certification confirming material VOCs in spreadsheet  |  | PE                                   |
| EQ4.3                 |  | Low Emitting Materials: Carpet Systems                      | Closeout                      | Spreadsheet indicating, for each indoor carpet used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data.   |  | PE                                   |
|                       |  |   | Closeout                      | Spreadsheet indicating, for each indoor carpet cushion used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data - OR - Statement confirming no indoor carpet cushion was used for the project.   |  | PE                                   |
|                       |  |   | Closeout                      | X Manufacturer published product data or certification confirming material CRI label in spreadsheet   |  | PE                                   |
| EQ4.4                 |  | Low Emitting Materials: Composite Wood & Agrifiber Products | Closeout                      | Spreadsheet indicating, for each indoor composite wood and agrifiber product used, the manufacturer, product name/model number, if it contains added urea formaldehyde (yes/no) and source of LEED compliance data.   |  | PE                                   |
|                       |  |   | Closeout                      | X Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet   |  | PE                                   |
| EQ5                   |  | Indoor Chemical & Pollutant Source Control                  | Closeout OCT09REV             | Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system. Roll-up and carpet systems requiring weekly cleaning to earn this credit are not a permitted option for Army projects.  |  | PE                                   |
|                       |  |   | Final Design                  | List of drawing and specification references that convey locations and installation methods for entryway systems.   |  | ARC                                  |
|                       |  |   | Final Design                  | Spreadsheet indicating, for each chemical use area, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance. |  | ARC MEC                              |
|                       |  |   | Final Design                  | If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.  |  | ARC MEC                              |
|                       |  |   | Closeout OCT09REV             | If project includes chemical use areas: Spreadsheet indicating, for AHUs/mechanical ventilation equipment serving occupied areas, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy (yes/no) - OR - Statement confirming that project does not use mechanical equipment for ventilation of occupied areas.     |  | PE                                   |

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| PAR   |  | FEATURE                                     | DUE AT                        | REQUIRED DOCUMENTATION   | DATE   | REV                                  |
| EQ6.1   |  | Controllability of Systems: Lighting        | Final Design                  | Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.   |  | ELEC                                 |
|   |  |   | Final Design                  | For each shared multi-occupant space, provide a brief description of lighting controls.  |  | ELEC                                 |
|   |  |   | Final Design                  | Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.  |  | ELEC                                 |
| EQ6.2   |  | Controllability of Systems: Thermal Comfort | Final Design                  | Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.   |  | MEC                                  |
|   |  |   | Final Design                  | For each shared multi-occupant space, provide a brief description of thermal comfort controls.   |  | MEC                                  |
|   |  |   | Final Design                  | Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.   |  | MEC                                  |
| EQ7.1   |  | Thermal Comfort: Design                     | Final Design                  | Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.  |  | MEC                                  |
|   |  |   | Final Design                  | Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.  |  | MEC                                  |
| EQ7.2   |  | Thermal Comfort: Verification               | Final Design                  | Narrative describing the scope of work for the thermal comfort survey, including corrective action plan development  |  | MEC                                  |
| EQ8.1   |  | Daylight & Views: Daylight 75% of Spaces    | Final Design                  | Option 1: Table indicating all regularly occupied spaces with space area and space area with 2% daylighting factor. Sum of regularly occupied areas and regularly occupied areas with 2% daylighting factor. Percentage calculation of areas with 2% daylighting factor to total regularly occupied areas.   |  | ARC                                  |
|   |  |   | Final Design                  | Option 1: Glazing factor calculation table   |  | ARC                                  |
|   |  |   | Final Design                  | Option 2: Simulation model method, software and output data  |  | ARC                                  |
|   |  |   | Final Design                  | Option 2: Table indicating all regularly occupied spaces with space area, space area with minimum 25 footcandles daylighting illumination, and method of providing glare control. Sum of regularly occupied areas and regularly occupied areas with 25 fc daylighting. Percentage calculation of areas with 25 fc daylighting to total regularly occupied areas. |  | ARC                                  |
|   |  |   | Final Design                  | For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.   |  | ARC                                  |
|   |  |   | Final Design                  | List of drawing and specification references that convey exterior glazed opening head and sill heights and glazing performance properties.   |  | ARC                                  |
|   |  |   | Closeout                      | Manufacturer published product data or certification confirming glazing Tvis in spreadsheet  |  | PE                                   |
| EQ8.2   |  | Daylight & Views: Views for 90% of Spaces   | Final Design                  | Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.   |  | ARC                                  |
|   |  |   | Final Design                  | For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.   |  | ARC                                  |
|   |  |   | Final Design                  | LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.  |  | ARC                                  |
| <b>CATEGORY 6 – FACILITY DELIVERY PROCESS</b> |  |   |                               |  |  |                                      |
| IDc1.1  |  | Innovation in Design                        | Final Design<br>OCT09REV      | Narrative describing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.  |  |                                      |
| IDc1.2  |  | Innovation in Design                        | Final Design<br>OCT09REV      |  |  |                                      |
| IDc1.3  |  | Innovation in Design                        | Final Design<br>OCT09REV      |  |  |                                      |
| IDc1.4  |  | Innovation in Design                        | Final Design<br>OCT09REV      |  |  |                                      |
| IDc2  |  | LEED Accredited Professional                | Final Design                  | Narrative indicating name of LEED AP, company name of LEED AP, description of LEED AP's role and responsibilities in the project.  |  | ARC                                  |

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**ATTACHMENT F**  
Version 07-07-2010

**BUILDING INFORMATION MODELING REQUIREMENTS**

**1.0 Section 1 - Submittal Format**

1.1. Design Deliverables. Develop all designs using Building Information Modeling (BIM) and Computer Aided Design (CAD) software. Design submittal drawings shall be Full Size size, suitable for half-size scaled reproduction.

**2.0 Section 2 – Design Requirements**

2.1. BIM Model and Facility Data. Contractor shall use BIM application(s) and software(s) to develop project designs. "Facility Data" is defined as associated intelligent attribute data. The "Model" is defined as 3D graphics that includes Facility Data and output as described in the paragraph 'Output' below. Contractors will use the Model to produce accurate Construction Documents. For each Center of Standardization (CoS) facility type included in this project, all BIM Models and associated Facility Data shall be submitted in Bentley Systems BIM [Not Supplied - SubmittalReqCADDSystem : BENTLEY\_VERSION] with associated USACE Bentley BIM Workspace (which includes specific standard BIM libraries and definitions). This Workspace can be downloaded from the CAD/BIM Technology Center. [Where available, the workspace will be specific to this CoS Facility Standard Design. The Contractor will be provided a baseline multi-discipline BIM Project Model for the CoS Facility Standard Design type, where such a model exists (for the purposes of site adaptation).] The USACE Bentley BIM Workspace is dependent on specific versions of the Bentley BIM suite of products and only the versions of the software that are listed in the Contractor instructions included with the USACE BIM Workspace are permitted to be used.

2.1.1. Reference. Refer to ERDC TR-06-10, "U.S. Army Corps of Engineers Building Information Modeling Road Map" from the CAD/BIM Technology Center website for more information on the USACE BIM implementation goals.

2.2. Drawings. Deliver CAD files used for the creation of the Construction Documents Drawings per requirements in Section 01 33 16, the criteria of the USACE Fort Worth District Corps of Engineers District, and as noted herein. Specification of a CAD file format for these Drawings does not limit which BIM application(s) or software(s) may be used for project development and execution.

2.2.1. IFC Support. The Contractor's selected BIM application(s) and software(s) must support the IFC (Industry Foundation Class - see [www.iai-tech.org](http://www.iai-tech.org)). Submit any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment for Government approval.

2.2.2. Submittal Requirements. BIM submittals shall be fully interoperable, compatible, and editable with the Bentley BIM tools. Use the specified version of the USACE Bentley BIM Workspace and conform to the requirements of **Sections 3 and 4 below**.

2.2.3. BIM Project Execution Plan.

2.2.3.1. Develop a BIM Project Execution Plan ("Plan" or "PxP") documenting the BIM and analysis technologies selected for the Project Model (integrated with the AEC CAD Standard) from concept development through As-Builts as a design, production, coordination, construction, and documentation tool and the collaborative process by which it shall be executed. See Section 7 for additional guidance on developing the Plan.

2.2.4. BIM Requirements..

2.2.4.1. Facility Data. Develop the Facility Data consisting of a set of intelligent elements for the Model (e.g., doors, air handlers, electrical panels). This Facility Data shall include all material definitions and attributes that are necessary for the Project facility design and construction. Additional data in support of Section 6 Contractor Electives is encouraged.

2.2.4.2. Model Content. The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.4.3. Model Granularity. Models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a quarter inch (1/4" = 1'0") scaled drawing (e.g. at least 1/16<sup>th</sup>, 1/8<sup>th</sup> and 1/4<sup>th</sup>), or appropriately scaled civil drawings.

2.2.4.4. Output. Submitted CAD drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) and maintained from the submitted Model and Facility Data.

2.3. Quality Control. Implement quality control (QC) parameters for the Model, including:

2.3.1. Model Standards Checks. QC validation used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Report non-compliant elements and corrective action plan to correct non-compliant elements. Provide the government with detailed justification and request government approval for any non-compliant element which the contractor proposes to be allowed to remain in the Model.

2.3.2. CAD Standards Checks. QC checking performed to ensure that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per the A/E/C CADD Standard.

2.3.3. Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for concurrence.

2.4. Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.4.1. Visual Checks. Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.4.2. Interference Management Checks. Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural or mechanical vs. mechanical overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation) in a written report and resolve.

2.4.3. IFC Coordination View. Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements.

2.4.4. Other Parameters. Develop such other Review parameters as the Contractor deems appropriate for the Project and provide to the Government for concurrence..

### **3.0 Section 3 – Design Stage Submittal Requirements**

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with BIM Project Execution Plan deliverables at stages as described hereinafter.

3.1.2. At each Stage in Paragraphs 3.3 through 3.6, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.3 and 2.4 have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Stage in Paragraphs 3.3 through 3.6, provide the Government with:

- The Model, Facility Data, Workspace and CAD Data files in native Bentley BIM/CAD.

- A 3-D interactive review format of the Model in Bentley Navigator, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per Plan requirements. The file format for reviews can change between submittals.

- A list of all submitted files. The list should include a description, directory, and file name for each file submitted. For all CAD sheets, include the sheet title and sheet number. Identify files that have been produced from the submitted Model and Facility Data.

3.1.4. The Government will confirm acceptability of all submittals identified in Section 3 in coordination with the USACE Fort Worth District Corps of Engineers BIM Manager

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the Plan where, in addition to Paragraph 3.1.4, the USACE Geographic District BIM Manager will coordinate with the USACE CoS BIM Manager to confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated.

3.2.2. Within thirty (30) days after the approval of the Plan, conduct a demonstration to review the Plan for clarification, and to verify the functionality of Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the Plan and perform subsequent demonstration for Government acceptance. There will be no payment for design or construction until the Plan is acceptable to the Government. The Government may also withhold payment for design and construction for unacceptable performance in executing the approved Plan.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4. Acceptance according to Paragraph 3.1.4 is required before commencement of construction, as described in Paragraph 3.7.6 of Section 01 33 16.

3.5. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

3.6. Final As-Built BIM and CAD Data Submittal. Submit the final Model, Facility Data, and CAD files reflecting as-built conditions for Government Approval, as specified in Section 01 78 02.00 10, PROJECT CLOSEOUT.

#### **4.0 Section 4 – BIM Model Minimum Requirements and Output**

4.1. General Provisions. The deliverable Model shall be developed to include the systems described below as they would be built and the processes of installing them, and to reflect final as-built conditions. The deliverable model at the interim design stage and at the final design stage (“released for construction”) shall be developed to include as many of the systems described below as are necessary and appropriate at that design stage.

4.2. Architectural/Interior Design. The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”) scaled drawing. Additional minimum Model requirements include:

4.2.1. Spaces. The Model shall include spaces defining accurate net square footage and net volume, and holding data for the room finish schedule for including room names and numbers. Include Programmatic Information provided by the Government or validated program to verify design space against programmed space, using this information to validate area quantities.

4.2.2. Walls and Curtain Walls. Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.2.3. Doors, Windows and Louvers. Doors, windows and louvers shall be depicted to represent their actual size, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules.

4.2.4. Roof. The Model shall include the roof configuration, drainage system, penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted.

4.2.5. Floors. The floor slab shall be developed in the structural Model and then referenced by the architectural Model for each floor of the Project building.

4.2.6. Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and generic wall sections where ceiling design elements are depicted.

4.2.7. Vertical Circulation. All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.8. Architectural Specialties and Woodwork. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and woodwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.9. Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.

4.2.10. Schedules. Provide door, window, hardware sets using BHMA designations, flooring, wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.

4.3. Furniture. The furniture systems Model may vary in level of detail for individual elements within a Model, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing, and have necessary intelligence to produce accurate plans. Representation of furniture elements is to be 2D. Contractor may provide a minimal number of 3D representations as examples. Examples of furniture include, but are not limited to, desks, furniture systems, seating, tables, and office storage.

4.3.1. Furniture Coordination. Furniture that makes use of electrical, data or other features shall include the necessary intelligence to produce coordinated documents and data.

4.4. Equipment. The Model may vary in level of detail for individual elements within a Model. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and minimum schedules depicting their configuration. Examples of equipment include but are not limited to copiers, printers, refrigerators, ice machines and microwaves.

4.4.1. Schedules. Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements.

4.5. Structural. The structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.5.1. Foundations. All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations

4.5.2. Floor Slabs. Structural floor slabs shall be depicted, including all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.



4.5.3. Structural Steel. All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans and related building/wall sections.

4.5.4. Cast-in-Place Concrete. All walls, columns, and beams, including necessary intelligence to produce accurate plans and building/wall sections depicting cast-in-place concrete elements.

4.5.5. Expansion/Contraction Joints. Joints shall be accurately depicted.

4.5.6. Stairs. The structural Model shall include all necessary openings and framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.

4.5.7. Shafts and Pits. The structural Model shall include all necessary shafts, pits, and openings, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

4.6. Mechanical. The mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required in the model. Additional minimum Model requirements include:

4.6.1. HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, registers, diffusers, grills and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules.

4.6.1.1. Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules.

4.6.2. Plumbing. All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.

4.6.3. Equipment Clearances. All HVAC and Plumbing equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. Elevator Equipment. The Model shall include the necessary equipment and control system, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. Electrical/Telecommunications. The electrical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2"Ø) field-routed conduit is not required in the model. Additional minimum Model requirements include:

4.7.1. Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards, cable trays and control systems), including necessary intelligence to produce accurate plans, details and schedules. Lighting and power built into furniture/equipment shall be modeled.

4.7.2. Special Electrical Systems. All necessary special electrical components (i.e., security, Mass Notification, Public Address, nurse call and other special occupancies, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding Systems. Grounding Systems. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Communications. All existing and new communications service controls and connections, both above ground and underground with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents.

4.7.5. Exterior Building Lighting. All necessary exterior lighting with necessary intelligence to produce accurate plans, elevations and schedules. The exterior building lighting Model shall include all necessary lighting, relevant existing and proposed support utility lines and equipment required with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances. The model shall incorporate and define all electrical and communications working spaces, clearances, and required access

4.8. Fire Protection. The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.8.1. Fire Protection System. All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled.

4.8.2. Fire Alarms. Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

4.9. Civil. The civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

4.9.1. Terrain (DTM). All relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.

4.9.2. Drainage. All existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.3. Storm Water and Sanitary Sewers. All existing and new sewer structures and piping, including upgrades thereto, on the Project site with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.4. Utilities. All necessary new utilities connections from the Project building(s) to the existing or newly-created utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.

4.9.5. Roads and Parking. All necessary roadways and parking lots or parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

## **5.0 Section 5 - Ownership and Rights in Data**

5.1. Ownership. The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN (Section 00 73 00). The Government may make use of this data following any deliverable.

## **6.0 Section 6 – Contractor Electives**

6.1. Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit during the source selection, as described in the proposal submission requirements and evaluation criteria, the following criteria are requirements, as applicable to those elective feature(s).

6.2. COBIE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements as defined by the Whole Building Design Guide organization, including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate file formats that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.3. Project Scheduling using the Model. In the BIM Execution Plan and during the Preliminary BIM Execution Plan Review, provide an overview of the use of BIM in the development and support of the project construction schedule.

6.3.1. Submittal Requirements. During the Submittal stages, the Contractor shall deliver the construction schedule with information derived from the Model.

6.3.1.1. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for project scheduling.

6.4. Cost Estimating. In the BIM Execution Plan and during the Preliminary BIM Execution Plan Review, provide an overview of the use of BIM in the development and support of cost estimating requirements, or other applications such as cost analysis and estimate validation.

6.4.1. Submittal Requirements. During the Submittal stages, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project completion. At project completion, the Contractor shall provide an MII (Micro Computer Aided Cost Estimating System Generation II) Cost Estimate which follows the USACE Cost Engineering Military Work Breakdown System (WBS), a modified Uniformat, to at least the sub-systems level and uses quantity information supplied directly from BIM output to the maximum extent possible, though other "Gap" quantity information will be included as necessary for a complete and accurate cost estimate.

6.4.2.1. Sub system level extracted quantities from the BIM for use within the estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. Therefore, when developing a BIM, the designer shall be cognizant of what tasks need to be separated appropriately at the beginning stages of model development, such as tasks done on the first floor versus the same task on higher floors that will be more labor intensive and therefore need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the BIM shall be broken down by their location (proximity in the structure) as well as the complexity of its installation.

6.4.2.2. At all design stages it shall be understood that BIM output as described in this document will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the project based on the design. An example of this would be plumbing that is less than 1.5" diameter and therefore not expected to be modeled due to granularity; this information is commonly referred to as The Gap. Quantities from The Gap and their associated costs shall be included in the final project actual cost estimates as well.

6.5. Other Analyses and Reports. Structural, energy and efficiency, EPACT 2005 & EISA 2007, lighting design, daylighting, electrical power, psychrometric processing, shading, programming, LEED, fire protection, code compliance, Life Cycle Cost, acoustic, plumbing.

## **7.0 Section 7 – BIM Project Execution Plan Template**

7.1. Contractors will utilize the latest version of the USACE BIM PROJECT EXECUTION PLAN (USACE PxP) Template to develop an acceptable Plan. The template can be downloaded from the CAD/BIM Technology Center website.





**ATTACHMENT G****DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT**

Organize electronic design submittal files in a subdirectory/file structure in accordance with the following table. The Contractor may suggest a slightly different structure, subject to the discretion of the government.

**Design Submittal Directory and Subdirectory File Arrangement.**

| Directory              | Sub-Directory                  | Sub-Directory or Files   | Files  |
|------------------------|--------------------------------|--|--|
| Submittal/Package Name | Narratives                     | PDF file or files with updated design narrative for each applicable design discipline                            |  |
|                        | Drawings                       | PDF (subdirectory)   | Single PDF file with all applicable drawing sheets - bookmarked by sheet number and name   |
|                        |                                | BIM (subdirectory) See Attachment F.   | BIM project folder (with files) per the USACE Workspace. Include an Excel drawing index file with each drawing sheet listed by sheet #, name and corresponding dgn file name (Final Design & Design Complete only) |
|                        | Design Analysis & Calculations | Individual PDF files containing design analysis and calculations for each discipline applicable to the submittal |  |
|                        |                                | PDF file with Fire Protection and Life Safety Code Review checklist  |  |
|                        | LEED                           | PDF file with updated Leed Check List  |  |
|                        |                                | PDF file or files with LEED Templates for each point with applicable documentation included in each file.        |  |
|                        |                                | LEED SUBMITTALS  |  |
|                        | Energy Analysis                | PDF with baseline energy consumption analysis  |  |
|                        |                                | PDF with actual building energy consumption analysis   |  |
|                        | Specifications                 | Single PDF file with table of contents and all applicable specifications sections.                               |  |
|                        |                                | Submittal Register (Final Design & Design Complete submittal only)   |  |
|                        | Design Quality Control         | PDF file or files with DQC checklist(s) and/or statements  |  |
|                        | Building Rendering(s)          | PDF file of rendering for each building type included in contract (Final Design & Design Complete).              |  |

**SECTION 01 45 04.00 10  
CONTRACTOR QUALITY CONTROL**

**1.0 GENERAL**

1.1. REFERENCES

1.2. PAYMENT

**2.0 PRODUCTS (NOT APPLICABLE)**

**3.0 EXECUTION**

3.1. GENERAL REQUIREMENTS

3.2. QUALITY CONTROL PLAN

3.3. COORDINATION MEETING

3.4. QUALITY CONTROL ORGANIZATION

3.5. SUBMITTALS AND DELIVERABLES

3.6. CONTROL

3.7. TESTS

3.8. COMPLETION INSPECTION

3.9. DOCUMENTATION

3.10. NOTIFICATION OF NONCOMPLIANCE

## **1.0 GENERAL**

### **1.1. REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to the latest edition, as of the date of the contract solicitation.

- ASTM INTERNATIONAL (ASTM)
- ASTM D 3740 Minimum Requirements for Agencies  
Engaged in the Testing and/or Inspection  
of Soil and Rock as Used in Engineering  
Design and Construction
- ASTM E 329 Agencies Engaged in the Testing  
and/or Inspection of Materials Used in  
Construction
- U.S. ARMY CORPS OF ENGINEERS (USACE)  
ER 1110-1-12 Quality Management

### **1.2. PAYMENT**

There will be no separate payment for providing and maintaining an effective Quality Control program. Include all costs associated therewith in the applicable unit prices or lump-sum prices contained in the Contract Line Item Schedule.

## **2.0 PRODUCTS (Not Applicable)**

## **3.0 EXECUTION**

### **3.1. GENERAL REQUIREMENTS**

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product, which complies with the contract requirements. The system shall cover all design and construction operations, both onsite and offsite, and shall be keyed to the proposed design and construction sequence. The site project superintendent is responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager at the site, responsible for the overall site activities, including but not limited to quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site. Different contractors have different names for the on-site overall project supervisor. For clarification, the term "site project superintendent" refers to the Contractor's senior site representative or "on-site manager", or other similar title, as those terms are used in contract Clause 52.236-7, "Superintendence by the Contractor" and in the Division 00 Section(s) of the solicitation for this contract or task order, or elsewhere in the contract. It does not refer to a construction superintendent, unless that person is also the Contractor's permanently assigned senior site representative in charge of all on-site activities.

### **3.2. QUALITY CONTROL PLAN**

Furnish for Government review, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Design and construction may begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. The Government will not permit work outside of the features of work included in an accepted interim plan to begin until acceptance of a CQC Plan or another interim plan containing the additional features of



work to be started. Where the applicable Code issued by the International Code Council calls for an inspection by the Building Official, the Contractor shall include the inspections in the Quality Control Plan and shall perform the inspections. The Designer of Record shall develop a program for any special inspections required by the applicable International Codes and the Contractor shall perform these inspections, using qualified inspectors. Include the special inspection plan in the QC Plan.

### 3.2.1. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

3.2.1.1. A description of the quality control organization. Include a chart showing lines of authority and an acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. A CQC System Manager shall report to the project superintendent or someone higher in the contractor's organization.

3.2.1.2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Also include those responsible for performing and documenting the inspections required by the International Codes and the special inspection program developed by the designer of record.

3.2.1.3. A copy of the letter to the CQC System Manager, signed by an authorized official of the firm, which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Furnish copies of these letters.

3.2.1.4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

3.2.1.5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Use only Government approved Laboratory facilities.

3.2.1.6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

3.2.1.7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

3.2.1.8. Reporting procedures, including proposed reporting formats.

3.2.1.9. A list of the definable features of work. A definable feature of work is a task, which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

3.2.1.10. A list of all inspections required by the International Codes and the special inspection program required by the code and this contract.

### 3.2.2. Additional Requirements for Design Quality Control (DQC) Plan

The following additional requirements apply to the Design Quality Control (DQC) plan:

3.2.2.1. The Contractor's QCP Plan shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design-build contract are performed and

provided in a manner that meets professional architectural and engineering quality standards. As a minimum, competent, independent reviewers identified in the DQC Plan shall review all documents. Use personnel who were not involved in the design effort to produce the design to perform the independent technical review (ITR). The ITR is intended as a quality control check of the design. Include, at least, but not necessarily limited to, a review of the contract requirements (the accepted contract or task order proposal and amended RFP), the basis of design, design calculations, the design configuration management documentation and check the design documents for errors, omissions, and for coordination and design integration. The ITR team is not required to examine, compare or comment concerning alternate design solutions but should concentrate on ensuring that the design meets the contract requirements. Correct errors and deficiencies in the design documents prior to submitting them to the Government.

3.2.2.2. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists at each design phase as part of the project documentation.

3.2.2.3. A Design Quality Control Manager, who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated, shall implement the DQC Plan. This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. Notify the Government, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

### 3.2.3. Acceptance of Plan

Government acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.4. Notification of Changes

After acceptance of the CQC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to Government acceptance.

## 3.3. COORDINATION MEETING

After the Postaward Conference, before start of design or construction, and prior to acceptance by the Government of the CQC Plan, the Contractor and the Government shall meet and discuss the Contractor's quality control system. Submit the CQC Plan for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, design activities, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. The Government will prepare minutes of the meeting for signature by both parties. The minutes shall become a part of the contract file. There may be occasions when either party will call for subsequent conferences to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## 3.4. QUALITY CONTROL ORGANIZATION

### 3.4.1. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure contract compliance. The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be

responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

#### 3.4.2. CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a BA/BS graduate of an ACCE accredited construction management college program. The CQC system Manager may alternately be an engineering technician with at least 2 years of college and an ICC certification as a Commercial Building Inspector (Residential Building Inspector certification will be required for Military Family Housing projects). In addition, the CQC system manager shall have a minimum of 5 years construction experience on construction similar to this contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. Assign the CQC System Manager no other duties (except may also serve as Safety and Health Officer, if qualified and if allowed by Section 00 73 00). Identify an alternate for the CQC System Manager in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager but the alternate may have other duties in addition to serving in a temporary capacity as the acting QC manager.

#### 3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract provide specialized CQC personnel to assist the CQC System Manager in accordance with paragraph titled Area Qualifications.

3.4.3.2. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; **are not intended to be full time, but must be physically present at the construction site during work on their areas of responsibility**; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. **One person may cover more than one area, provided that they are qualified to perform QC activities for the designated areas below and provided that they have adequate time to perform their duties:**

#### 3.4.4. Experience Matrix

##### 3.4.4.1. Area Qualifications

3.4.4.1.1. Civil - Graduate Civil Engineer or (BA/BS) graduate in construction management with 4 years experience in the type of work being performed on this project or engineering technician with 5 yrs related experience.

3.4.4.1.2. Mechanical - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Mechanical Inspector with 5 yrs related experience.

3.4.4.1.3. Electrical - Graduate Electrical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Electrical Inspector with 5 yrs related experience.

3.4.4.1.4. Structural - Graduate Structural Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or person with an ICC certification as a Reinforced Concrete Special Inspector and Structural Steel and Bolting Special Inspector (as applicable to the type of construction involved) with 5 yrs related experience.

3.4.4.1.5. Plumbing - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience, or person with an ICC certification as a Commercial Plumbing Inspector with 5 yrs related experience.

3.4.4.1.6. Concrete, Pavements and Soils Materials Technician (present while performing tests) with 2 yrs experience for the appropriate area

3.4.4.1.7. Testing, Adjusting and Balancing Specialist must be a member (TAB) Personnel of AABC or an experienced technician of the firm certified by the NEBB (present while testing, adjusting, balancing).

3.4.4.1.8. Design Quality Control Manager Registered Architect or Professional Engineer (not required on the construction site)

3.4.4.1.9. Registered Fire Protection Engineer with 4 years related experience or engineering technician with 5 yrs related experience (but see requirements for Fire Protection Engineer of Record to witness final testing in Section 01 10 00, paragraph 5.10, Fire Protection).

3.4.4.1.10. QC personnel assigned to the installation of the telecommunication system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification. In lieu of BICSI certification, QC personnel shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. QC personnel shall witness and certify the testing of telecommunications cabling and equipment.

### 3.4.5. Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors". This course is periodically offered at [Not Supplied - ConstructionReqQC : COURSE\_LOCATION]. Inquire of the District or Division sponsoring the course for fees and other expenses involved, if any, for attendance at this course.

### 3.4.6. Organizational Changes

When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

## 3.5. SUBMITTALS AND DELIVERABLES

Make submittals as specified in Section 01 33 00 **SUBMITTAL PROCEDURES**. The CQC organization shall certify that all submittals and deliverables are in compliance with the contract requirements.

## 3.6. CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. The CQC organization shall conduct at least three phases of control for each definable feature of the construction work as follows:

### 3.6.1. Preparatory Phase

Perform this phase prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

3.6.1.1. A review of each paragraph of applicable specifications, reference codes, and standards. Make a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field at the preparatory inspection. Maintain these copies in the field, available for use by Government personnel until final acceptance of the work.

3.6.1.2. A review of the contract drawings.

3.6.1.3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

3.6.1.4. Review of provisions that have been made to provide required control inspection and testing.

3.6.1.5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

3.6.1.6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

3.6.1.7. A review of the appropriate activity hazard analysis to assure safety requirements are met.

3.6.1.8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

3.6.1.9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

3.6.1.10. Discussion of the initial control phase.

3.6.1.11. Notify the Government at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.6.2. Initial Phase

Accomplish this phase at the beginning of a definable feature of work. Include the following actions:

3.6.2.1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

3.6.2.2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3.6.2.3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

3.6.2.4. Resolve all differences.

3.6.2.5. Check safety to include compliance with and upgrading of the Accident Prevention plan and activity hazard analysis. Review the activity analysis with each worker.

3.6.2.6. Notify the Government at least 24 hours in advance of beginning the initial phase. The CQC System Manager shall prepare and attach to the daily CQC report separate minutes of this phase. Indicate exact location of initial phase for future reference and comparison with follow-up phases.

3.6.2.7. Repeat the initial phase any time acceptable specified quality standards are not being met.

### 3.6.3. Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Conduct final follow-up checks and correct deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

### 3.6.4. Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

## 3.7. TESTS

### 3.7.1. Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements and project design documents. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory, or establish an approved testing laboratory at the project site. The Contractor may elect to use a laboratory certified and accredited by the Concrete and cement Reference Laboratory (CCRL) or by AASHTO Materials Reference Laboratory (AMRL) for testing procedures that those organizations certify. The Contractor shall perform the following activities and record and provide the following data:

3.7.1.1. Verify that testing procedures comply with contract requirements and project design documents.

3.7.1.2. Verify that facilities and testing equipment are available and comply with testing standards.

3.7.1.3. Check test instrument calibration data against certified standards.

3.7.1.4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

3.7.1.5. Include results of all tests taken, both passing and failing tests, recorded on the CQC report for the date taken. Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2. Testing Laboratories

#### 3.7.2.1. Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

#### 3.7.2.2. Capability Recheck

If the selected laboratory fails the capability check, the Government will assess the Contractor a charge of \$1,375 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

### 3.7.3. Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

### 3.7.4. Furnishing or Transportation of Samples for Government Quality Assurance Testing

The Contractor is responsible for costs incidental to the transportation of samples or materials. Deliver samples of materials for test verification and acceptance testing by the Government to the Corps of Engineers Laboratory, f.o.b., at the following address:

- For delivery by mail:
  - [Not Supplied - ConstructionReqQC : LAB\_NAME]
  - [Not Supplied - ConstructionReqQC : LAB\_ATTN]
  - [Not Supplied - ConstructionReqQC : LAB\_MAIL]

[Not Supplied - ConstructionReqQC : LAB\_STATE]

- For other deliveries:

[Not Supplied - ConstructionReqQC : LAB\_NAME\_OTHER]

[Not Supplied - ConstructionReqQC : LAB\_ATTN\_OTHER]

[Not Supplied - ConstructionReqQC : LAB\_MAIL\_OTHER]

[Not Supplied - ConstructionReqQC : LAB\_STATE\_OTHER]

The area or resident office will coordinate, exact delivery location, and dates for each specific test.

### 3.8. COMPLETION INSPECTION

#### 3.8.1. Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. Prepare a punch list of items which do not conform to the approved drawings and specifications and include in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

#### 3.8.2. Pre-Final Inspection

As soon as practicable after the notification above, the Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. Accomplish these inspections and any deficiency corrections required by this paragraph within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

#### 3.8.3. Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall attend the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups and major commands may also attend. The Government will formally schedule the final acceptance inspection based upon results of the Pre-Final inspection. Provide notice to the Government at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

### 3.9. DOCUMENTATION

3.9.1. Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers using government-provided software, QCS (see Section 01 45 01.10). The report includes, as a minimum, the following information:

3.9.1.1. Contractor/subcontractor and their area of responsibility.

3.9.1.2. Operating plant/equipment with hours worked, idle, or down for repair.

3.9.1.3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

3.9.1.4. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the applicable control phase (Preparatory, Initial, Follow-up). List deficiencies noted, along with corrective action.

3.9.1.5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

3.9.1.6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

3.9.1.7. Offsite surveillance activities, including actions taken.

3.9.1.8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

3.9.1.9. Instructions given/received and conflicts in plans and/or specifications.

3.9.1.10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identity of the ITR team, the ITR review comments, responses and the record of resolution of the comments.

3.9.2. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, submit one report for every 7 days of no work and on the last day of a no work period. Account for all calendar days throughout the life of the contract. The first report following a day of no work shall be for that day only. The CQC System Manager shall sign and date reports. The report shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. The Contractor may submit these forms electronically, in lieu of hard copy.

### 3.10. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of Section 01 45 04.00 10



**SECTION 01 50 02.0001**  
**TEMPORARY CONSTRUCTION FACILITIES**

**1.0 OVERVIEW**

1.1. GENERAL REQUIREMENTS

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

## **1.0 OVERVIEW**

### **1.1. GENERAL REQUIREMENTS**

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 50 02 apply to this task order, except as otherwise specified herein.

### **1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN**

1.3.1. Bulletin Board (As Specified in Base contract)

1.3.2. Project and Safety Signs (Added to Stress standardization of signs, in the event that the Base ID/IQ Section 01 50 02 does not contain this information)

Erect a project sign and a site safety sign with informational details as provided by the Government at the Post award conference, within 15 days prior to any work activity on project site. Update the safety sign data daily, with light colored metallic or non-metallic numerals. Remove the signs from the site upon completion of the project. Engineer Pamphlet EP 310-1-6a contains the standardized layout and construction details for the signs. It can be found through a GOOGLE Search or try <http://www.usace.army.mil/publications/eng-pamphlets/ep310-1-6a/s-16.pdf>.

End of Section 01 50 02.0001

## **Appendix A**

### **Geotech**



GEOTECHNICAL SERVICES

## **SUBSURFACE EXPLORATION**

Central Issue Facility  
Randolph Road and Currie Road  
Ft. Sill, Oklahoma

PROJECT NO. 7309-3055



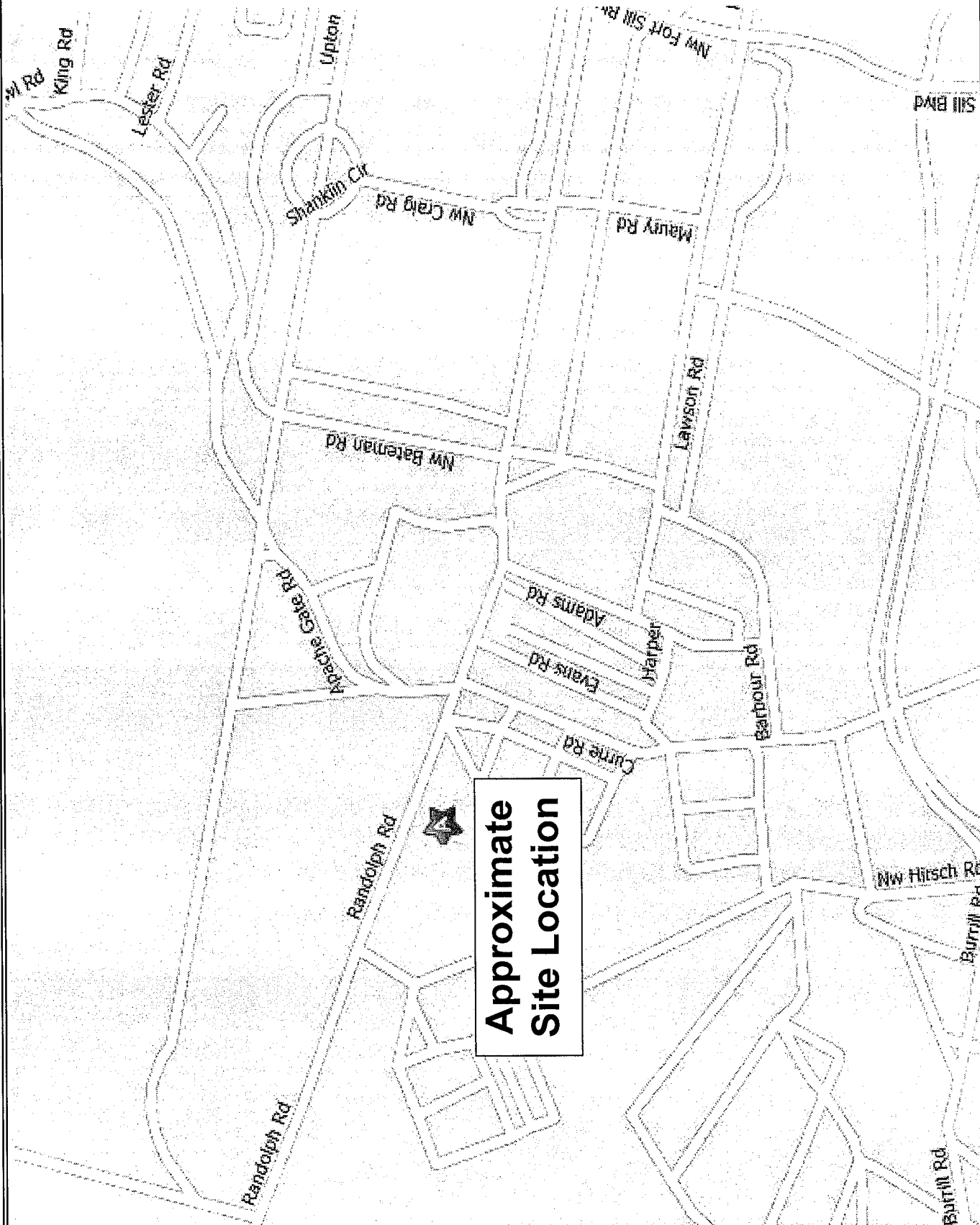
## **APPENDIX A**

### **Vicinity Map**

### **Site and Boring Location Plan**



NOT TO SCALE



**Approximate  
Site Location**

Vicinity Map



Project Name: Central Issue Facility  
Project Location: Randolph Road and Currie Road, Ft. Sill, Oklahoma  
Project No.: 7309-3055

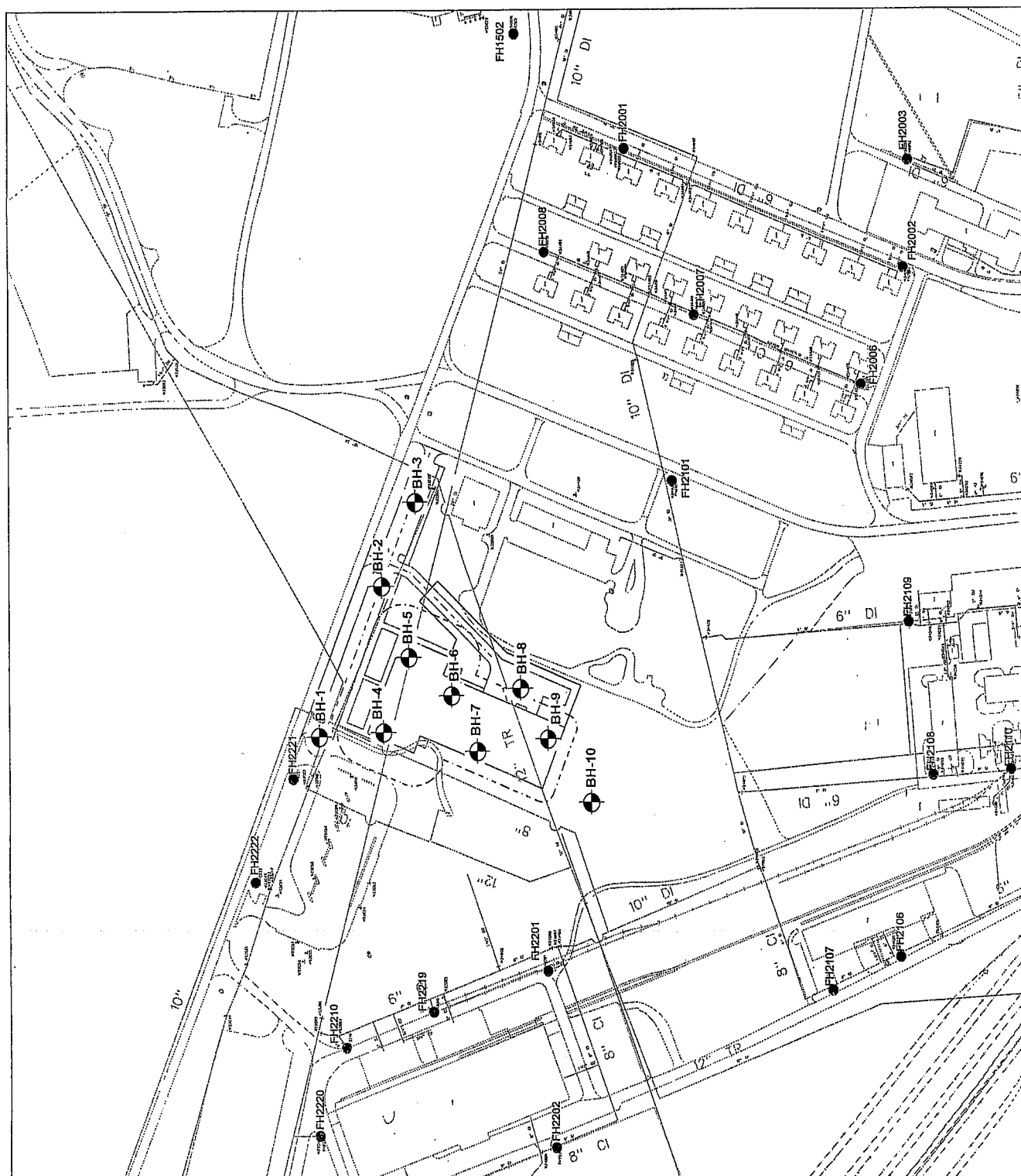
| BORING DATA |           |           |
|-------------|-----------|-----------|
| NO.         | NORTHING  | EASTING   |
| BH-1        | 142877.00 | 142877.00 |
| BH-2        | 142877.00 | 142877.00 |
| BH-3        | 142877.00 | 142877.00 |
| BH-4        | 142877.00 | 142877.00 |
| BH-5        | 142877.00 | 142877.00 |
| BH-6        | 142877.00 | 142877.00 |
| BH-7        | 142877.00 | 142877.00 |
| BH-8        | 142877.00 | 142877.00 |
| BH-9        | 142877.00 | 142877.00 |
| BH-10       | 142877.00 | 142877.00 |
| BH-11       | 142877.00 | 142877.00 |
| BH-12       | 142877.00 | 142877.00 |
| BH-13       | 142877.00 | 142877.00 |
| BH-14       | 142877.00 | 142877.00 |
| BH-15       | 142877.00 | 142877.00 |
| BH-16       | 142877.00 | 142877.00 |
| BH-17       | 142877.00 | 142877.00 |
| BH-18       | 142877.00 | 142877.00 |
| BH-19       | 142877.00 | 142877.00 |
| BH-20       | 142877.00 | 142877.00 |

NOTE:  
1. GEOTECHNICAL REPORT IS INCLUDED  
IN APPENDIX A OF THE SPECIFICATIONS  
2. SEE SHEETS 006 THRU 011 FOR BORING LOGS.

LEGEND  
● BORING LOCATION  
● ARCHEOLOGICAL SITE  
(SEE NOTES AND N. SHEET 0002)  
● TESTED FIRE HYDRANT



Scale refers to the  
full size drawing



Site and Boring Location Plan

Project Name: Central Issue Facility  
 Project Location: Randolph Road and Currie Road, Ft. Sill, Oklahoma  
 Project No.: 7309-3055

**STANDARD**  
**TESTING**  
 AND ENGINEERING COMPANY



GEOTECHNICAL SERVICES

**APPENDIX B**

**Boring Logs**

**Key to Symbols**

**Definition of Descriptive Terms**



# SOIL BORING LOG

Boring No. BH-1Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 01/28/09Boring Location: N. corner of the building pad footprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1193.3 ft.Water Depth: Dry @ CompletionRemarks: Surface elevation provided by client

| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |    |    |    |    |    |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|                     |                   |                            |                  |                         |                         | PL                  |    |    |    |    | LL | Water Content, % - ● |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |                   |                            |                  |                         |                         | 10                  | 20 | 30 | 40 | 50 | 60 |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |                   |                            |                  |                         |                         |                     |    |    |    |    |    |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-2Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 01/28/09Boring Location: E. corner of the building pad footprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1181.4 ft.Water Depth: Dry @ CompletionRemarks: Surface elevation provided by the client

| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity  |                   |
|---------------------|-------------------|----------------------------|--|-------------------------|-------------------------|----------------------|-------------------|
|                     |                   |                            |  |                         |                         | PL                   | LL                |
|                     |                   |                            |  |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
|                     |                   |                            |  |                         |                         | Water Content, % - ● |                   |
|                     |                   |                            |  |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
| 0                   |                   |                            | Brn. CLAY WITH SAND<br>Sl. Moist, Fl. High Plasticity  |                         |                         |                      |                   |
| 1180                |                   |                            | Reddish Brn. FAT CLAY WITH SAND w/ Gravel<br>Sl. Moist, High Plasticity<br>USCS: CH; AASHTO: A-7-6(33)<br>LL = 61, PI = 40 |                         | 79.2                    |                      |                   |
| 5                   |                   |                            |  |                         |                         |                      |                   |
| 1175                |                   |                            | Moist<br>LL = 49, PI = 30  |                         |                         |                      |                   |
| 10                  |                   |                            |  |                         |                         |                      |                   |
| 1170                |                   |                            |  |                         |                         |                      |                   |
| 15                  |                   |                            |  |                         |                         |                      |                   |
| 1165                |                   |                            |  |                         |                         |                      |                   |
| 20                  |                   |                            |  |                         |                         |                      |                   |
| 1160                |                   |                            |  |                         |                         |                      |                   |
| 25                  |                   |                            |  |                         |                         |                      |                   |
| 1155                |                   |                            |  |                         |                         |                      |                   |
| 30                  |                   |                            |  |                         |                         |                      |                   |
| 1150                |                   |                            |  |                         |                         |                      |                   |

# SOIL BORING LOG

Boring No. BH-3Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 01/28/09Boring Location: E. corner of the building pad footprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1176.1 ft.Water Depth: Dry @ CompletionRemarks: Surface elevation provided by the client

| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |    |
|---------------------|-------------------|----------------------------|--|-------------------------|-------------------------|---------------------|----|
|                     |                   |                            |  |                         |                         | PL                  | LL |
| 1175                |                   |                            | Brn. CLAY WITH SAND w/ Gravel<br>Moist, High Plasticity<br>USCS: CL; AASHTO: A-7-6(23)<br>LL = 47, PI = 31 |                         | 77.2                    |                     |    |
| 1170                |                   |                            | Reddish Brn., Fl. High Plasticity<br>LL = 43, PI = 27  |                         |                         |                     |    |
| 1165                |                   |                            |  |                         |                         |                     |    |
| 1160                |                   |                            |  |                         |                         |                     |    |
| 1155                |                   |                            |  |                         |                         |                     |    |
| 1150                |                   |                            |  |                         |                         |                     |    |
| 1145                |                   |                            |  |                         |                         |                     |    |



GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-4Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/17/09Boring Location: N. Corner of Building FootprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / "3.25" I.D.- 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1194.0 ft.Water Depth: 8 ft. after 24 hrs.Remarks: Surface elevation provided by client

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |                   |
|---------------------|--------|---------|----------------------------|--|-------------------------|-------------------------|---------------------|-------------------|
|                     |        |         |                            |  |                         |                         | PL                  | LL                |
|                     |        |         |                            |  |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
| 0                   |        |         |                            | Reddish Brn. CLAY WITH SAND<br>Sl. Moist, Fl. High Plasticity<br>LL = 50, PI = 25<br>Unconfined Compression Test<br>qu = 2.1 tsf @ 4.0% strain (0 to 2 ft.)<br>USCS: CL; AASHTO: A-7-6(20) | 99                      | 78.1                    |                     |                   |
| 1190                |        | 5/6"    |                            | LL = 47, PI = 25<br>UU Triaxial Test<br>c = 11.4 psi, phi = 28.2 deg. (2 to 4 ft.)   | 118                     |                         |                     |                   |
| 5                   |        | 12/6"   |                            | Lt. Brn. CLAY WITH SAND w/ Gravel<br>Moist, Fl. High Plasticity, V. Stiff<br>LL = 40, PI = 24  | 113                     |                         |                     |                   |
|                     |        | 20/6"   |                            |  |                         |                         |                     |                   |
|                     |        | 4/6"    |                            |  |                         |                         |                     |                   |
|                     |        | 12/6"   |                            |  |                         |                         |                     |                   |
|                     |        | 11/6"   |                            |  |                         |                         |                     |                   |
| 1185                |        | 50/6"   |                            | (ROCK) Lt. Brn. & Gray SANDSTONE<br>Sl. Moist, Nonplastic, Soft  |                         |                         |                     |                   |
| 10                  |        |         | 50/2.5"                    | Medium Hard<br>Unconfined Compression Test<br>qu = 20.9 tsf @ 3.0% strain (10.8 to 11.2 ft.)   | 124                     |                         |                     |                   |
| 1180                |        |         |                            |  |                         |                         |                     |                   |
| 15                  |        |         |                            | RQD = 72% (10.5 to 15.5 ft.)   |                         |                         |                     |                   |
| 1175                |        |         |                            |  |                         |                         |                     |                   |
| 20                  |        |         |                            | RQD = 72% (15.5 to 20.5 ft.)<br>Unconfined Compression Test<br>qu = 44.9 tsf @ 1.4% strain (20.5 to 20.9 ft.)<br>(ROCK) Gray SHALE   | 126                     |                         |                     |                   |
| 1170                |        |         |                            |  |                         |                         |                     |                   |
| 25                  |        |         |                            | RQD = 10% (20.5 to 25.5 ft.)   |                         |                         |                     |                   |
| 1165                |        |         |                            |  |                         |                         |                     |                   |
| 30                  |        |         |                            | RQD = 10% (25.5 to 30.5 ft.)   |                         |                         |                     |                   |



## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-5Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/13/09Boring Location: E. Corner of Building FootprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / "3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1187.1 ft.Water Depth: 9 ft. after 24 hrs.Remarks: Surface elevation provided by client

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description                               | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity  |                   |
|---------------------|--------|---------|----------------------------|--|-------------------------|-------------------------|----------------------|-------------------|
|                     |        |         |                            |  |                         |                         | PL                   | LL                |
|                     |        |         |                            |  |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
|                     |        |         |                            |  |                         |                         | Water Content, % - ● |                   |
|                     |        |         |                            |  |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
| 0                   |        | 2/6"    |                            | Brn. SANDY CLAY w/ Root Fibers                 |                         |                         |                      |                   |
|                     |        | 5/6"    |                            | Sl. Moist, Med. Plasticity, Stiff              | 102                     |                         |                      |                   |
| 1185                |        | 7/6"    |                            |  |                         |                         |                      |                   |
|                     |        | 5/6"    |                            | Lt. Brn. & Gray                                | 115                     | 69.6                    |                      |                   |
|                     |        | 11/6"   |                            | V. Stiff                                       |                         |                         |                      |                   |
|                     |        | 13/6"   |                            | USCS: CL; AASHTO: A-7-6(13)                    |                         |                         |                      |                   |
|                     |        | 10/6"   |                            | LL = 44, PI = 20                               |                         |                         |                      |                   |
| 5                   |        | 10/6"   |                            |  | 114                     |                         |                      |                   |
|                     |        | 50/5.5" |                            | (ROCK) Brn. SANDSTONE                          |                         |                         |                      |                   |
|                     |        | 24/6"   |                            | Sl. Moist, Nonplastic, Soft                    |                         |                         |                      |                   |
| 1180                |        | 50/3.5" |                            |  |                         |                         |                      |                   |
|                     |        | 12/6"   |                            | Reddish Brn. SANDY CLAY w/ Gravel              |                         |                         |                      |                   |
|                     |        | 8/6"    |                            | Moist, Med. Plasticity, V. Stiff               |                         |                         |                      |                   |
|                     |        | 9/6"    |                            |  |                         |                         |                      |                   |
| 10                  |        | 5/6"    |                            |  |                         |                         |                      |                   |
|                     |        | 9/6"    |                            |  |                         |                         |                      |                   |
| 1175                |        | 18/6"   |                            |  |                         |                         |                      |                   |
|                     |        |         |                            |  |                         |                         |                      |                   |
| 15                  |        | 6/6"    |                            |  |                         |                         |                      |                   |
|                     |        | 10/6"   |                            |  |                         |                         |                      |                   |
| 1170                |        | 11/6"   |                            |  |                         |                         |                      |                   |
|                     |        |         |                            |  |                         |                         |                      |                   |
| 20                  |        | 5/6"    |                            | LL = 53, PI = 20                               | 98                      |                         |                      |                   |
|                     |        | 10/6"   |                            |  |                         |                         |                      |                   |
| 1165                |        | 16/6"   |                            |  |                         |                         |                      |                   |
|                     |        |         |                            |  |                         |                         |                      |                   |
| 25                  |        | 8/6"    |                            | Grayish Brn. CLAY                              | 103                     |                         |                      |                   |
|                     |        | 13/6"   |                            | Sl. Moist, Med. Plasticity, V. Stiff           |                         |                         |                      |                   |
| 1160                |        | 25/6"   |                            |  |                         |                         |                      |                   |
|                     |        |         |                            |  |                         |                         |                      |                   |
| 30                  |        | 35/6"   |                            | (ROCK) Gray SHALE                              | 113                     |                         |                      |                   |
|                     |        | 50/4.3" |                            | Sl. Moist, Low Plasticity, Soft                | 131                     |                         |                      |                   |
|                     |        |         |                            | LL = 26, PI = 10                               |                         |                         |                      |                   |
|                     |        |         |                            | Unconfined Compression Test                    |                         |                         |                      |                   |
| 1155                |        |         |                            | qu = 21.0 tsf @ 2.8% strain (30.2 to 30.6 ft.) |                         |                         |                      |                   |

Page: 1 of 2 for boring BH-5

Friday, February 18, 2011

# SOIL BORING LOG

Boring No. BH-5 continuedProject: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/13/09

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description  | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity  |    |    |    |    |    |    |
|---------------------|--------|---------|----------------------------|---|-------------------------|-------------------------|----------------------|----|----|----|----|----|----|
|                     |        |         |                            |   |                         |                         | PL                   | 10 | 20 | 30 | 40 | 50 | 60 |
|                     |        |         |                            |   |                         |                         | Water Content, % - ● |    |    |    |    |    |    |
|                     |        |         |                            |   |                         |                         | 10                   | 20 | 30 | 40 | 50 | 60 |    |
| 35                  |        |         |                            | RQD = 66% (30 to 35 ft.)  |                         |                         |                      |    |    |    |    |    |    |
| 1150                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 40                  |        |         |                            | RQD = 66% (35 to 40 ft.)  |                         |                         |                      |    |    |    |    |    |    |
| 1145                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 45                  |        |         |                            | Unconfined Compression Test<br>qu = 26.3 tsf (44.8 to 45.2 ft.)<br>RQD = 81% (40 to 45 ft.) | 128                     |                         |                      |    |    |    |    |    |    |
| 1140                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 50                  |        |         |                            | RQD = 81% (45 to 50 ft.)  |                         |                         |                      |    |    |    |    |    |    |
| 1135                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 55                  |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 1130                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 60                  |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 1125                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 65                  |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |
| 1120                |        |         |                            |   |                         |                         |                      |    |    |    |    |    |    |

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GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-6Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/17/09 -02/18/09Boring Location: N. Corner of Building FootprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / "3.25" I.D.- 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1188.6 ft.Water Depth: 9.3 ft. after 24 hrs.Remarks: Surface elevation provided by client; 5" Shelby Tube (0-7')


| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |                   |
|---------------------|-------------------|----------------------------|--|-------------------------|-------------------------|---------------------|-------------------|
|                     |                   |                            |  |                         |                         | PL                  | LL                |
|                     |                   |                            |  |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
| 0                   |                   |                            | Dk. Brn. SILTY CLAY w/ Root Fibers<br>Sl. Moist, Fl. Low Plasticity  |                         |                         |                     |                   |
| 1185                |                   |                            | Lt. Brn. FAT CLAY WITH SAND w/ Gravel<br>Moist, High Plasticity<br>LL = 55, PI = 35<br>Unconfined Compression Test<br>qu = 3.5 tsf @ 2.5% strain (2 to 4 ft.)<br>USCS: CH; AASHTO: A-7-6(26)<br>LL = 57, PI = 32 | 98                      | 76.9                    |                     |                   |
| 5                   |                   |                            | Lt. Brn. SHALE<br>Moist, Low Plasticity<br>LL = 30, PI = 10<br>(ROCK) Brn. SANDSTONE<br>Sl. Moist, Nonplastic, Soft  | 108                     |                         |                     |                   |
| 1180                |                   | 7/6"<br>50/5"              |  |                         |                         |                     |                   |
| 10                  |                   | 50/5.5"                    |  |                         |                         |                     |                   |
| 1175                |                   |                            | Very Hard @ 15.5 ft.<br>RQD = 91% (10.5 to 15.5 ft.)<br>Unconfined Compression Test<br>qu = 364.1 tsf (15.5 to 15.9 ft.)<br>(ROCK) Gray LIMESTONE, Very Hard<br>(ROCK) Brn. SANDSTONE                            | 132                     |                         |                     |                   |
| 15                  |                   |                            | RQD = 91% (15.5 to 20.5 ft.)   |                         |                         |                     |                   |
| 1170                |                   |                            |  |                         |                         |                     |                   |
| 20                  |                   |                            |  |                         |                         |                     |                   |
| 1165                |                   |                            |  |                         |                         |                     |                   |
| 25                  |                   |                            | RQD = 0% (20.5 to 25.5 ft.)  |                         |                         |                     |                   |
| 1160                |                   |                            |  |                         |                         |                     |                   |
| 30                  |                   |                            | RQD = 0% (25.5 to 30.5 ft.)<br>(ROCK) Brn. & Gray SHALE w / Interbedded<br>SANDSTONE<br>Unconfined Compression Test<br>qu = 20.5 tsf (31.9 to 32.3 ft.)  | 136                     |                         |                     |                   |
| 1155                |                   |                            |  |                         |                         |                     |                   |



## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-6 continuedProject: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/17/09 -02/18/09

| Elev./Depth<br>Feet | Symbol  | Samples | SPT<br>Blows/<br>Increment | Soil Description             | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity  |    |    |    |    |    |    |
|---------------------|---|---------|----------------------------|------------------------------|-------------------------|-------------------------|----------------------|----|----|----|----|----|----|
|                     |   |         |                            |                              |                         |                         | PL                   | 10 | 20 | 30 | 40 | 50 | 60 |
|                     |   |         |                            |                              |                         |                         | Water Content, % - ● |    |    |    |    |    | LL |
|                     |   |         |                            |                              |                         |                         | 10                   | 20 | 30 | 40 | 50 | 60 |    |
| 35                  |  |         |                            | RQD = 83% (30.5 to 35.5 ft.) |                         |                         |                      |    |    |    |    |    |    |
| 1150                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 40                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 1145                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 45                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 1140                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 50                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 1135                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 55                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 1130                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 60                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 1125                |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |
| 65                  |   |         |                            |                              |                         |                         |                      |    |    |    |    |    |    |

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Friday, February 18, 2011





## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-7Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/13/09 & 2/16/09Boring Location: W. Corner of Building FootprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / "3.25" I.D.- 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1194.0 ft.Water Depth: 12 ft. after 24 hrs.Remarks: Surface elevation provided by client

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |                   |
|---------------------|--------|---------|----------------------------|--|-------------------------|-------------------------|---------------------|-------------------|
|                     |        |         |                            |  |                         |                         | PL                  | LL                |
|                     |        |         |                            |  |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
|                     |        |         |                            |  |                         |                         | Water Content, % -  |                   |
|                     |        |         |                            |  |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
| 0                   |        |         | 3/6"                       | Dk. Brn. CLAY WITH SAND w/ Root Fibers                             |                         |                         |                     |                   |
|                     |        |         | 8/6"                       | Moist, Fl. High Plasticity, Stiff                                  | 98                      |                         |                     |                   |
|                     |        |         | 4/6"                       | LL = 44, PI = 24   |                         |                         |                     |                   |
|                     |        |         | 4/6"                       | Brn. FAT CLAY WITH SAND  | 110                     | 73.1                    |                     |                   |
|                     |        |         | 6/6"                       | Sl. Moist, High Plasticity, V. Stiff                               |                         |                         |                     |                   |
|                     |        |         | 10/6"                      | USCS: CH; AASHTO: A-7-6(22)  |                         |                         |                     |                   |
| 1190                |        |         | 3/6"                       | LL = 55, PI = 30   | 113                     |                         |                     |                   |
| 5                   |        |         | 9/6"                       |  |                         |                         |                     |                   |
|                     |        |         | 10/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 4/6"                       | LL = 57, PI = 29   | 101                     |                         |                     |                   |
|                     |        |         | 9/6"                       |  |                         |                         |                     |                   |
|                     |        |         | 12/6"                      |  |                         |                         |                     |                   |
| 1185                |        |         | 4/6"                       |  | 99                      |                         |                     |                   |
|                     |        |         | 7/6"                       |  |                         |                         |                     |                   |
|                     |        |         | 24/6"                      |  |                         |                         |                     |                   |
| 10                  |        |         | 11/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 19/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 50/3.5"                    | (ROCK) Lt. Brn. & Gray SHALE w / Interbedded<br>SANDSTONE & Gravel | 119                     |                         |                     |                   |
|                     |        |         |                            | Sl. Moist, Fl. Low Plasticity, Soft                                |                         |                         |                     |                   |
| 1180                |        |         |                            | LL = 33, PI = 12   |                         |                         |                     |                   |
| 15                  |        |         | 16/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 48/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 50/3.8"                    |  |                         |                         |                     |                   |
| 1175                |        |         |                            | Reddish Brn. SANDY CLAY  |                         |                         |                     |                   |
|                     |        |         |                            | Sl. Moist, Low Plasticity  |                         |                         |                     |                   |
| 20                  |        |         | 9/6"                       | Fl. Low Plasticity, V. Stiff                                       | 122                     |                         |                     |                   |
|                     |        |         | 13/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 15/6"                      |  |                         |                         |                     |                   |
| 1170                |        |         |                            |  |                         |                         |                     |                   |
| 25                  |        |         | 9/6"                       | Reddish Brn. & Gray SHALE  | 112                     |                         |                     |                   |
|                     |        |         | 22/6"                      | Sl. Moist, Med. Plasticity, V. Stiff                               |                         |                         |                     |                   |
|                     |        |         | 32/6"                      |  |                         |                         |                     |                   |
| 1165                |        |         |                            |  |                         |                         |                     |                   |
| 30                  |        |         | 19/6"                      |  |                         |                         |                     |                   |
|                     |        |         | 28/6"                      | (ROCK) Brn. & Gray SHALE   | 112                     |                         |                     |                   |
|                     |        |         | 50/5.8"                    | Sl. Moist, Fl. Low Plasticity, Soft                                |                         |                         |                     |                   |
|                     |        |         |                            | LL = 49, PI = 15   |                         |                         |                     |                   |



## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-7 continuedProject: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/13/09 & 2/16/09

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |    |
|---------------------|--------|---------|----------------------------|--|-------------------------|-------------------------|---------------------|----|
|                     |        |         |                            |  |                         |                         | PL                  | LL |
| 1160                |        |         |                            |  |                         |                         | 10 20 30 40 50 60   |    |
| 35                  |        |         |                            | Unconfined Compression Test<br>qu = 3.4 tsf @ 1.0% strain (32.4 to 32.8 ft.)<br>RQD = 68% (31.5 to 36.5 ft.) |                         |                         |                     |    |
| 1155                |        |         |                            |  |                         |                         |                     |    |
| 40                  |        |         |                            | RQD = 68% (36.5 to 41.5 ft.)   |                         |                         |                     |    |
|                     |        |         |                            | (ROCK) Brn. & Gray SANDSTONE w / Interbedded SHALE   |                         |                         |                     |    |
| 1150                |        |         |                            |  |                         |                         |                     |    |
| 45                  |        |         |                            | RQD = 100% (41.5 to 46.5 ft.)<br>Unconfined Compression Test<br>qu = 81.7 tsf (45.4 to 45.8 ft.)             | 119                     |                         |                     |    |
| 1145                |        |         |                            |  |                         |                         |                     |    |
| 50                  |        |         |                            | RQD = 100% (46.5 to 51.5 ft.)  |                         |                         |                     |    |
| 1140                |        |         |                            |  |                         |                         |                     |    |
| 55                  |        |         |                            |  |                         |                         |                     |    |
| 1135                |        |         |                            |  |                         |                         |                     |    |
| 60                  |        |         |                            |  |                         |                         |                     |    |
| 1130                |        |         |                            |  |                         |                         |                     |    |
| 65                  |        |         |                            |  |                         |                         |                     |    |



## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-8Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 01/28/09Boring Location: S. corner of the building pad footprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1185.9 ft.Water Depth: Dry @ CompletionRemarks: Surface elevation provided by the client

| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |    |
|---------------------|-------------------|----------------------------|--|-------------------------|-------------------------|---------------------|----|
|                     |                   |                            |  |                         |                         | PL                  | LL |
| 0                   |                   |                            | Dk. Brn. SILTY CLAY<br>Sl. Moist, Fl. Low Plasticity   |                         |                         | 10 20 30 40 50 60   |    |
| 1185                |                   |                            |  |                         |                         |                     |    |
|                     |                   |                            | Dk. Brn. FAT CLAY WITH SAND<br>Sl. Moist, High Plasticity<br>USCS: CH; AASHTO: A-7-6(27)<br>LL = 54, PI = 33 |                         | 80.2                    |                     |    |
| 5                   |                   |                            |  |                         |                         |                     |    |
| 1180                |                   |                            | Reddish Brn.   |                         |                         |                     |    |
|                     |                   |                            |  |                         |                         |                     |    |
| 10                  |                   |                            |  |                         |                         |                     |    |
| 1175                |                   |                            |  |                         |                         |                     |    |
|                     |                   |                            |  |                         |                         |                     |    |
| 15                  |                   |                            |  |                         |                         |                     |    |
| 1170                |                   |                            |  |                         |                         |                     |    |
|                     |                   |                            |  |                         |                         |                     |    |
| 20                  |                   |                            |  |                         |                         |                     |    |
| 1165                |                   |                            |  |                         |                         |                     |    |
|                     |                   |                            |  |                         |                         |                     |    |
| 25                  |                   |                            |  |                         |                         |                     |    |
| 1160                |                   |                            |  |                         |                         |                     |    |
|                     |                   |                            |  |                         |                         |                     |    |
| 30                  |                   |                            |  |                         |                         |                     |    |
| 1155                |                   |                            |  |                         |                         |                     |    |



## GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-9Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/16/09 -02/17/09Boring Location: S.W. Corner of Building FootprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / "3.25" I.D.- 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1190.8 ft.Water Depth: 29.5 ft. after 24 hrsRemarks: Surface elevation provided by client

| Elev./Depth<br>Feet | Symbol | Samples                 | SPT<br>Blows/<br>Increment | Soil Description   | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |                   |
|---------------------|--------|-------------------------|----------------------------|--|-------------------------|-------------------------|---------------------|-------------------|
|                     |        |                         |                            |  |                         |                         | PL                  | LL                |
|                     |        |                         |                            |  |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
| 1190                |        |                         |                            | Reddish Brn. FAT CLAY WITH SAND w/ Gravel & Root Fibers<br>Sl. Moist, Fl. High Plasticity,<br>LL = 43, PI = 25<br>High Plasticity<br>USCS: CH; AASHTO: A-7-5(28)<br>LL = 67, PI = 36<br>Unconfined Compression Test<br>qu = 3.1 tsf @ 1.6% strain (2 to 4 ft.)<br>UU Triaxial Test<br>c = 28.4 psi, phi = 3.9 deg. (4 to 6 ft.)<br>Fl. High Plasticity<br>Unconfined Compression Test<br>qu = 4.1 tsf @ 3.3% strain (6 to 8 ft.)<br>LL = 52, PI = 27 | 102                     | 74.0                    |                     |                   |
| 1185                |        |                         |                            |  | 111                     |                         |                     |                   |
| 1180                |        | 3/6"<br>12/6"<br>17/6"  |                            | Reddish Brn. CLAY WITH SAND<br>Sl. Moist, Med. Plasticity, V. Stiff  | 114                     |                         |                     |                   |
| 1175                |        | 5/6"<br>14/6"<br>23/6"  |                            |  | 116                     |                         |                     |                   |
| 1170                |        | 9/6"<br>14/6"<br>19/6"  |                            | Brn. & Gray  | 102                     |                         |                     |                   |
| 1165                |        | 7/6"<br>19/6"<br>24/6"  |                            | Reddish Brn. & Gray SHALE<br>Sl. Moist, Med. Plasticity, V. Stiff  | 105                     |                         |                     |                   |
| 1160                |        | 11/6"<br>19/6"<br>23/6" |                            |  | 100                     |                         |                     |                   |

# SOIL BORING LOG

Boring No. BH-9 continuedProject: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 02/16/09 -02/17/09

| Elev./Depth<br>Feet | Symbol | Samples | SPT<br>Blows/<br>Increment | Soil Description  | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity |                   |
|---------------------|--------|---------|----------------------------|---|-------------------------|-------------------------|---------------------|-------------------|
|                     |        |         |                            |   |                         |                         | PL                  | LL                |
|                     |        |         |                            |   |                         |                         | 10 20 30 40 50 60   | 10 20 30 40 50 60 |
| 1155                |        |         | 14/6"<br>18/6"<br>22/6"    | Reddish Brn. CLAY WITH SAND<br>Sl. Moist, Med. Plasticity, V. Stiff   | 104                     |                         |                     |                   |
| 1150                |        |         | 24/6"<br>35/6"<br>47/6"    | Brn. & Gray Weathered SHALE<br>Sl. Moist, Med. Plasticity, V. Stiff   | 117                     |                         |                     |                   |
| 1145                |        |         | 44/6"<br>50/4"             | (ROCK) Brn. & Gray SHALE<br>Sl. Moist, Med. Plasticity, Soft<br>LL = 40, PI = 20<br>Unconfined Compression Test<br>qu = 15.0 tsf @ 3.4% strain (46.0 to 46.4 ft.) | 124<br>128              |                         |                     |                   |
| 1140                |        |         |                            | Brn. & Gray SHALE w / Interbedded SANDSTONE<br>RQD = 78% (46 to 51 ft.)<br>Unconfined Compression Test<br>qu = 72.6 tsf (51.1 to 51.5 ft.)                        | 133                     |                         |                     |                   |
| 1135                |        |         |                            | RQD = 78% (51 to 56 ft.)  |                         |                         |                     |                   |
| 1130                |        |         |                            |   |                         |                         |                     |                   |
| 1125                |        |         |                            |   |                         |                         |                     |                   |

Page: 2 of 2 for boring BH-9



GEOTECHNICAL SERVICES

## SOIL BORING LOG

Boring No. BH-10Project: Central Issue FacilityProject No.: 7309-3055Project Location: Randolph Rd. & Currie Rd., Ft. Sill, OklahomaDate Drilled.: 01/28/09Boring Location: S.W. corner of the building pad footprintProject Engineer: Vajra Rai & J. PanDrill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSAField Logger: Johnny JarmanSurface Elevation: 1197.6 ft.Water Depth: Dry @ CompletionRemarks: Surface elevation provided by the client

| Elev./Depth<br>Feet | Symbol<br>Samples | SPT<br>Blows/<br>Increment | Soil Description  | Dry<br>Density<br>(pcf) | % Passing<br>#200 Sieve | Moisture/Plasticity  |                   |
|---------------------|-------------------|----------------------------|---|-------------------------|-------------------------|----------------------|-------------------|
|                     |                   |                            |   |                         |                         | PL                   | LL                |
|                     |                   |                            |   |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
|                     |                   |                            |   |                         |                         | Water Content, % - ● |                   |
|                     |                   |                            |   |                         |                         | 10 20 30 40 50 60    | 10 20 30 40 50 60 |
| 0                   |                   |                            | Reddish Brn. CLAY WITH SAND<br>Sl. Moist, Fl. High Plasticity |                         |                         |                      |                   |
| 1195                |                   |                            |   |                         |                         |                      |                   |
| 5                   |                   |                            | Reddish Brn. FAT CLAY WITH SAND<br>Sl. Moist, High Plasticity |                         |                         |                      |                   |
| 1190                |                   |                            | Brn.  |                         |                         |                      |                   |
| 10                  |                   |                            | LL = 68, PI = 46  |                         |                         |                      |                   |
| 1185                |                   |                            |   |                         |                         |                      |                   |
| 15                  |                   |                            |   |                         |                         |                      |                   |
| 1180                |                   |                            |   |                         |                         |                      |                   |
| 20                  |                   |                            |   |                         |                         |                      |                   |
| 1175                |                   |                            |   |                         |                         |                      |                   |
| 25                  |                   |                            |   |                         |                         |                      |                   |
| 1170                |                   |                            |   |                         |                         |                      |                   |
| 30                  |                   |                            |   |                         |                         |                      |                   |
| 1165                |                   |                            |   |                         |                         |                      |                   |

## KEY TO SYMBOLS

Symbol Description

### STRATA SYMBOLS



Silty Sand



Sandy Clay



Clay with Sand



Fat Clay with Sand



Clay with Sand w/ Gravel



Sandstone



Shale



Clay



Silty Clay



Limestone



Shale with Interbedded Sandstone

### Misc. Symbols



Water level at completion of  
drilling operations



Boring continues

### Soil Samplers



Bulk sample taken  
from auger flights, ASTM D1452



# KEY TO SYMBOLS

Symbol    Description



3" Undisturbed Thin-Walled Tube  
(Shelby tube), ASTM D1587



Standard Penetration Test, ASTM D1586



Diamond Core Drilling, ASTM D2113-83



5" Undisturbed Thin-Walled Tube  
(Shelby tube), ASTM D1587



**DEFINITION OF DESCRIPTIVE TERMS****Consistency of Cohesive Soils (at moisture content near plastic limit):**

Very Soft - Easily penetrated 4" to 6" by fist; tall core will sag under its own weight.

Soft - Easily molded by fingers.

Firm - Can be penetrated 2" to 3" by thumb with moderate effort, imprinted with fingers.

Stiff - Readily indented by thumb but penetrated only with great effort.

Very Stiff - Readily indented by thumbnail, imprinted very slightly with pressure from fingers.

Hard - Indented with difficulty by thumbnail, cannot be imprinted with fingers.

**Density of Cohesionless Soils:**

Very Loose - less than 4 SPT "N" value corrected for overburden.

Loose - 5 to 10 SPT "N" value corrected for overburden.

Medium Dense - 11 to 30 SPT "N" value corrected for overburden.

Dense - 31 to 50 SPT "N" value corrected for overburden.

Very Dense - 51 to 50/6" SPT "N" value corrected for overburden.

Hard - less than 6" penetration in 50 SPT "N" blows corrected for overburden (cemented).

**Hardness of Rock:**

Very Soft - can be scratched readily by fingernail

Soft - can be grooved readily by knife or pick

Medium - can be grooved 0.05" deep by firm pressure of knife

Moderately Hard - can be scratched by knife

Hard - can be scratched by knife or pick only with difficulty

Very Hard - cannot be scratched by knife or sharp pick

**Other Terms Descriptive of Consistency:**

Brittle - Ruptures with little deformation

Friable - Crumbles or pulverizes easily.

Elastic - Returns to original length after small deformation.

Spongy - Is very porous, loose and elastic.

Sticky - Adheres or sticks to tools or hands.

**In Situ Moisture Descriptions:**

Dry - powdery

Slightly Moist - water not readily absorbed by paper

Moist - water readily absorbed by paper

Very Moist - water condenses on sample tray

Wet - water drips from sample

**Degree of Plasticity When Moist to Very Moist:**

Nonplastic - cannot be rolled into a ball

Trace of Plasticity - can be rolled into a ball but not into a 1/8" thread

Low Plasticity - barely holds its shape when rolled into a 1/8" thread

Fairly Low Plasticity - 1/8" thread quickly ruptures when bent

Medium Plasticity - 1/8" thread withstands considerable deformation without rupture.

Fairly High Plasticity - difficult to rupture a 1/8" thread by bending.

High Plasticity - can be kneaded without rupture; greasy texture.

**Abbreviations:**

V. - Very

Tr. - Trace

Fl. - Fairly

Sl. - Slightly

Dk. - Dark

Lt. - Light

Med. - Medium

Blk. - Black

Brn. - Brown

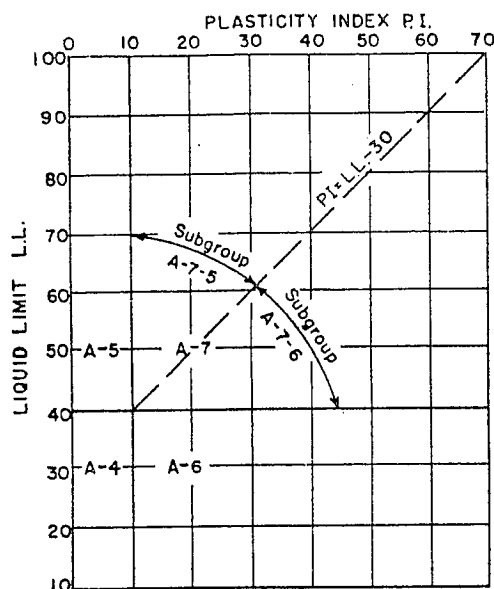


## **APPENDIX C**

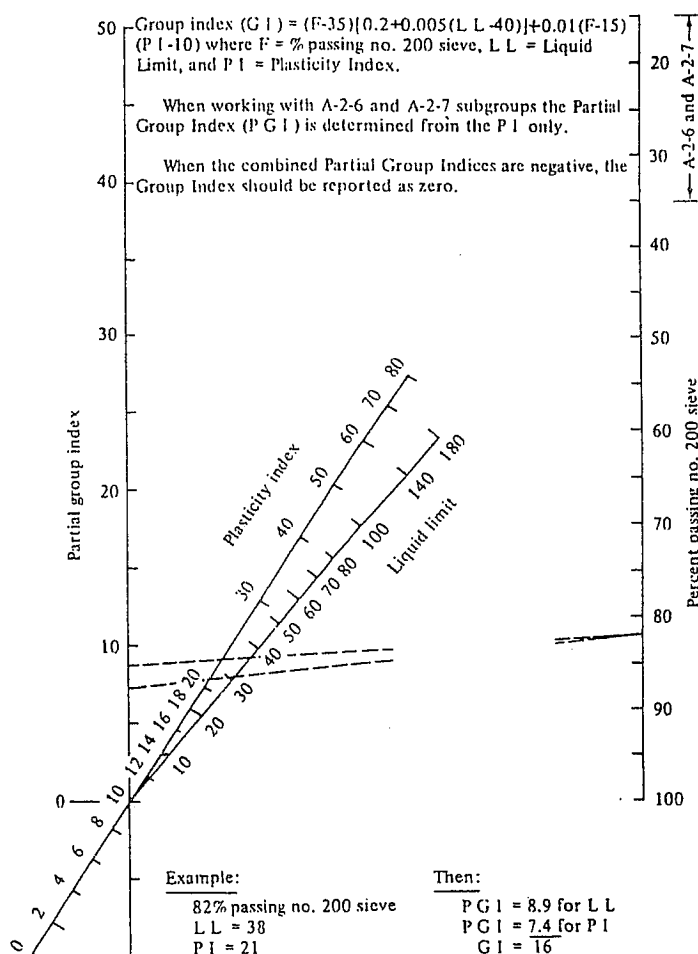
### **AASHTO Soil Classification System Unified Soil Classification System**

# Soil Classification System — American Association of State Highway and Transportation Officials

The tables and charts given below are from AASHTO Designation: M 145-83, The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. More detailed information as to the background and application of the system may be obtained from the report.



Liquid-limit and plasticity-index ranges for the A-4, A-5, A-6 and A-7 subgrade groups.



Group index chart

## Classification of Soils and Soil-Aggregate Mixtures (with Suggested Subgroups)

| General classification   | Granular materials<br>(35 per cent or less passing No. 200) |                         |                         |                   |                   |                   |                   | Silt-clay materials<br>(More than 35 per cent passing No. 200) |                   |                   |                   |
|--|---|-------------------------|-------------------------|-------------------|-------------------|-------------------|-------------------|--|-------------------|-------------------|-------------------|
| Group classification   | A-1   |                         | A-3                     | A-2               |                   |                   |                   | A-4  | A-5               | A-6               | A-7               |
|  | A-1-a   | A-1-b                   |                         | A-2-4             | A-2-5             | A-2-6             | A-2-7             |  |                   |                   | A-7-5; A-7-6      |
| Sieve analysis:<br>Per cent passing:<br>No. 10<br>No. 40<br>No. 200                | 50 max.<br>30 max.<br>15 max.                               | —<br>50 max.<br>25 max. | —<br>51 min.<br>10 max. | —<br>—<br>35 max. | —<br>—<br>35 max. | —<br>—<br>35 max. | —<br>—<br>35 max. | —<br>—<br>36 min.  | —<br>—<br>36 min. | —<br>—<br>36 min. | —<br>—<br>36 min. |
| Characteristics of fraction<br>passing No. 40:<br>Liquid limit<br>Plasticity index |   |                         |                         |                   |                   |                   |                   |  |                   |                   |                   |
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\*P.I. of A-7-5 subgroup is equal to or less than L.L. minus 30. P.I. of A-7-6 subgroup is greater than L.L. minus 30

| UNIFIED SOIL CLASSIFICATION<br>(Including Identification and Description)   |  |  |  |   |   |   |                   |   |  |  |                   |   |
|---|--|--|--|---|---|---|-------------------|---|--|--|-------------------|---|
| Major Divisions   |  | Group Symbols                                    | Typical Names  | Field Identification Procedures<br>(Excluding particles larger than 3 inches and basing fractions on estimated weights) |   | Information Required for Describing Soils   |                   | Laboratory Classification Criteria  |  |  |                   |   |
| 1   | 2  | 3  | 4  | 5   |   | 6   |                   | 7   |  |  |                   |   |
| Coarse-grained Soils<br>More than half of material is larger than No. 200 sieve size.<br>More than half of coarse fraction is larger than No. 4 sieve size.<br>(For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size.) | Gravels<br>More than half of coarse fraction is larger than No. 4 sieve size.  | Gravels with (Little or no fines)                | GW   | Well-graded gravels, gravel-sand mixtures, little or no fines.  |   | Wide range in grain sizes and substantial amounts of all intermediate particle sizes.   |                   | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 6<br>$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3 |  |  |                   |   |
|   |  |  | GP   | Poorly-graded gravels, gravel-sand mixtures, little or no fines.  |   |   |                   |   |  | Predominantly one size or a range of sizes with some intermediate sizes missing. |                   |   |
|   |  | Gravels with Fines (Appreciable amount of fines) | GM   | Silty gravels, gravel-sand-silt mixtures.   |   | Nonplastic fines or fines with low plasticity (for identification procedures see ML below).   |                   |   |  |  |                   |   |
|   |  |  | GC   | Clayey gravels, gravel-sand-clay mixtures.  |   |   |                   |   |  | Plastic fines (for identification procedures see CL below).                      |                   |   |
|   | Sands<br>More than half of coarse fraction is smaller than No. 4 sieve size.<br>(For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size.) | Clean Sands (Little or no fines)                 | SW   | Well-graded sands, gravelly sands, little or no fines.  |   | Wide range in grain size and Substantial amounts of all intermediate particle sizes.  |                   | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4<br>$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3 |  |  |                   |   |
|   |  |  | SP   | Poorly-graded sands, gravelly sands, little or no fines.  |   |   |                   |   |  | Predominantly one size or a range of sizes with some intermediate sizes missing. |                   |   |
|   |  | Sands with Fines (Appreciable amount of fines)   | SM   | Silty sands, sand-silt mixtures.  |   | Nonplastic fines or fines with low plasticity (for identification procedures see ML below).   |                   |   |  |  |                   | Not meeting all gradation requirements for GW<br>Atterberg limits below "A" line or PI less than 4<br>Above "A" line with PI between 4 and 7 are <u>borderline</u> cases requiring use of dual symbols. |
|   |  |  | SC   | Clayey sands, sand-clay mixtures.   |   |   |                   |   |  | Plastic fines (for identification procedures see CL below).                      |                   |   |
|   |  |  |  |   |   |   |                   |   |  |  |                   |   |
|   |  |  |  |   |   |   |                   |   |  |  |                   |   |
| Fine-grained Soils<br>More than half of material is smaller than No. 200 sieve size.<br>The No. 200 sieve size is about the smallest particle visible to the naked eye.   | Sils and Clays<br>Liquid limit less than 50  |  | Identification Procedures on Fraction Smaller than No. 40 Sieve Size |   |   | Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.<br><br>For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.<br><br>Example:<br>Clayey silt, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML). |                   |   |  |  |                   |   |
|   |  |  | ML   | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.     |   |   |                   |   |  | None to slight   | Quick to slow     | None  |
|   |  |  | CL   | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.                      |   |   |                   |   |  | Medium to high   | None to very Slow | Medium  |
|   |  |  | OL   | Organic silts and organic silty clays of low plasticity.  |   |   |                   |   |  | Slight to medium   | Slow              | Slight  |
|   |  |  | MH   | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.                                    |   |   |                   |   |  | Slight to medium   | Slow to none      | Slight to medium  |
|   |  |  | CH   | Inorganic clays of high plasticity, fat clays.  |   |   |                   |   |  | High to very high  | None              | High  |
|   | Sils and Clays<br>Liquid limit greater than 50   |  | OH   | Organic clays of medium to high plasticity, organic silts.  |   | Medium to high  | None to very slow |   |  | Slight to medium   |                   |   |
|   |  |  |  |   |   |   |                   |   |  |  |                   |   |
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| Highly Organic Soils  |  | Pt   | Peat and other highly organic soils.                                 |   | Readily identified by color, odor, spongy feel and frequently by fibrous texture. |   |                   |   |  |  |                   |   |

(1) Boundary classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder. (2) All sieve sizes on this chart are U. S. standard.

FIELD IDENTIFICATION PROCEDURES FOR FINE-GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking)

After removing particles larger than No. 40 sieve size, prepare a pot of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky. Place the pot in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pot which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and glass disappear from the surface, the pot stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics)

After removing particles larger than No. 40 sieve size, mold a pot of soil to the consistency of putty, adding water if necessary. Allow the pot to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit)

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is molded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached. After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.



GEOTECHNICAL SERVICES

**APPENDIX D**

**Summary of Laboratory Test Results**

## SUMMARY OF LABORATORY TEST RESULTS

Page 1 of 4

Client: Burns &amp; McDonnell Engineering Co., Inc

Date: April 1, 2009

Project: Central Issue Facility, Lawton, Oklahoma

Project No.: 7309-3055

| Boring No. | Sample I.D. | Depth (ft.) | Moisture Content (%) | Dry Density (pcf) | Atterberg Limits (% Moisture) |    |    |      | Sieve Analysis (% Passing) |     |     |      |      | Soil Classification |           | Unconfined Compression Test |            |
|------------|-------------|-------------|----------------------|-------------------|-------------------------------|----|----|------|----------------------------|-----|-----|------|------|---------------------|-----------|-----------------------------|------------|
|            |             |             |                      |                   | LL                            | PL | PI | 3/8" | #4                         | #10 | #40 | #100 | #200 | USCS                | AASHTO    | Stress (tsf)                | Strain (%) |
| BH-1       | B           | 2-4         | 9.3                  |                   | Nonplastic                    |    |    |      | 100                        | 100 | 100 | 100  | 36.6 | SM                  | A-4(0)    |                             |            |
|            | B           | 2-4         | 18.5                 |                   | 61                            | 21 | 40 | 100  | 100                        | 100 | 90  | 83   | 79.2 | CH                  | A-7-6(33) |                             |            |
|            | D           | 6-8         | 17.5                 |                   | 49                            | 19 | 30 |      |                            |     |     |      |      |                     |           |                             |            |
| BH-3       | A           | 0-2         | 19.8                 |                   | 47                            | 16 | 31 | 100  | 100                        | 100 | 92  | 82   | 77.2 | CL                  | A-7-6(23) |                             |            |
|            | C           | 4-6         | 14.8                 |                   | 43                            | 16 | 27 |      |                            |     |     |      |      |                     |           |                             |            |
| BH-4       | A           | 0-2         | 20.0                 | 99                | 50                            | 25 | 25 |      |                            |     |     |      |      |                     |           | 2.1                         | 4.0        |
|            | B           | 2-4         | 15.2                 |                   | 47                            | 22 | 25 | 100  | 100                        | 100 | 93  | 84   | 78.1 | CL                  | A-7-6(20) |                             |            |
|            | C           | 4-5.5       | 15.1                 | 118               | 40                            | 16 | 24 |      |                            |     |     |      |      |                     |           |                             |            |
|            | D           | 6-7.5       | 15.5                 | 113               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | E           | 8-9.5       | 4.3                  |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | F           | 10-10.5     | 10.6                 |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
| BH-5       | Rock Core   | 10.8-11.2   | 11.8                 | 124               |                               |    |    |      |                            |     |     |      |      |                     |           | 20.9                        | 3.0        |
|            |             | 20.5-20.9   | 9.3                  | 126               |                               |    |    |      |                            |     |     |      |      |                     |           | 44.9                        | 1.4        |
|            | A           | 0-1.5       | 18.5                 | 102               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | B           | 2-3.5       | 11.9                 | 115               | 44                            | 24 | 20 | 100  | 100                        | 100 | 85  | 77   | 69.6 | CL                  | A-7-6(13) |                             |            |
|            | C           | 4-5.5       | 10.8                 | 114               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | D           | 6-7.5       | 5.7                  |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | E           | 8-9.5       | 21.1                 |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|            | F           | 10-11.5     | 19.9                 |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |



## GEOTECHNICAL SERVICES

## SUMMARY OF LABORATORY TEST RESULTS

Page 2 of 4

Date: April 1, 2009

Client: Burns &amp; McDonnell Engineering Co., Inc

Project No.: 7309-3055

Project: Central Issue Facility, Lawton, Oklahoma

| Boring No.   | Sample I.D. | Depth (ft.)            | Moisture Content (%) | Dry Density (pcf) | Atterberg Limits (% Moisture) |    |    | Sieve Analysis (% Passing) |     |     |     |      |      | Soil Classification |           | Unconfined Compression Test |            |
|--------------|-------------|------------------------|----------------------|-------------------|-------------------------------|----|----|----------------------------|-----|-----|-----|------|------|---------------------|-----------|-----------------------------|------------|
|              |             |                        |                      |                   | LL                            | PL | PI | 3/8"                       | #4  | #10 | #40 | #100 | #200 | USCS                | AASHTO    | Stress (tsf)                | Strain (%) |
| BH-5 (cont.) | G           | 15-16.5                | 21.4                 |                   |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
|              | H           | 20-21.5                | 26.1                 | 98                | 53                            | 33 | 20 |                            |     |     |     |      |      |                     |           |                             |            |
|              | I           | 25-26.5                | 21.9                 | 103               |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
|              | J           | 29.5-30                | 8.9                  | 113               | 26                            | 16 | 10 |                            |     |     |     |      |      |                     |           |                             |            |
|              | Rock Core   | 30.2-30.6<br>44.8-45.2 | 9.9<br>10.7          | 131<br>128        |                               |    |    |                            |     |     |     |      |      |                     |           | 21.0<br>26.3                | 2.8<br>-   |
| BH-6         | A           | 0-2                    | 19.6                 |                   |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
|              | B           | 2-4                    | 24.9                 | 98                | 55                            | 20 | 35 |                            |     |     |     |      |      |                     |           | 3.5                         | 2.5        |
|              | C           | 4-6                    | 17.8                 |                   | 57                            | 25 | 32 | 100                        | 100 | 100 | 93  | 83   | 76.9 | CH                  | A-7-6(26) |                             |            |
|              | D           | 6-7                    | 18.4                 |                   | 30                            | 20 | 10 |                            |     |     |     |      |      |                     |           |                             |            |
|              | E           | 8-9.5                  | 15.3                 | 108               |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
| BH-7         | F           | 10-10.5                | 3.7                  |                   |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
|              | Rock Core   | 15.5-15.9<br>31.9-32.3 | 6.5<br>7.9           | 132<br>136        |                               |    |    |                            |     |     |     |      |      |                     |           | 364.1<br>20.5               | -<br>-     |
|              | A           | 0-1.5                  | 25.3                 | 98                | 44                            | 20 | 24 |                            |     |     |     |      |      |                     |           |                             |            |
|              | B           | 2-3.5                  | 17.3                 | 110               | 55                            | 25 | 30 | 100                        | 100 | 100 | 92  | 80   | 73.1 | CH                  | A-7-6(22) |                             |            |
|              | C           | 4-5.5                  | 14.9                 | 113               |                               |    |    |                            |     |     |     |      |      |                     |           |                             |            |
| D            | 6-7.5       | 24.3                   | 101                  | 57                | 28                            | 29 |    |                            |     |     |     |      |      |                     |           |                             |            |



## GEOTECHNICAL SERVICES

## SUMMARY OF LABORATORY TEST RESULTS

Page 3 of 4

Client: Burns &amp; McDonnell Engineering Co., Inc

Date: April 1, 2009

Project: Central Issue Facility, Lawton, Oklahoma

Project No.: 7309-3055

| Boring No.   | Sample I.D. | Depth (ft.) | Moisture Content (%) | Dry Density (pcf) | Atterberg Limits (% Moisture) |    |    |      | Sieve Analysis (% Passing) |     |     |      |      | Soil Classification |           | Unconfined Compression Test |            |
|--------------|-------------|-------------|----------------------|-------------------|-------------------------------|----|----|------|----------------------------|-----|-----|------|------|---------------------|-----------|-----------------------------|------------|
|              |             |             |                      |                   | LL                            | PL | PI | 3/8" | #4                         | #10 | #40 | #100 | #200 | USCS                | AASHTO    | Stress (tsf)                | Strain (%) |
| BH-7 (cont.) | E           | 8-9.5       | 23.2                 | 99                |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | F           | 10-11.5     | 10.0                 | 119               | 33                            | 21 | 12 |      |                            |     |     |      |      |                     |           |                             |            |
|              | G           | 15-16.5     | 11.7                 |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | H           | 20-21.5     | 8.0                  | 122               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | I           | 25-26.5     | 16.7                 | 112               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | J           | 30-31.5     | 17.6                 |                   | 49                            | 34 | 15 |      |                            |     |     |      |      |                     |           |                             |            |
| BH-8         | Rock Core   | 32.4-32.8   | 19.4                 | 112               |                               |    |    |      |                            |     |     |      |      |                     |           | 3.4                         | 1.0        |
|              |             | 45.4-45.8   | 13.5                 | 119               |                               |    |    |      |                            |     |     |      |      |                     |           | 81.7                        | -          |
| BH-9         | B           | 2-4         | 16.3                 |                   | 54                            | 21 | 33 | 100  | 100                        | 100 | 91  | 84   | 80.2 | CH                  | A-7-6(27) |                             |            |
|              | A           | 0-2         | 14.5                 |                   | 43                            | 18 | 25 |      |                            |     |     |      |      |                     |           |                             |            |
|              | B           | 2-4         | 16.3                 | 102               | 67                            | 31 | 36 | 100  | 98                         | 98  | 89  | 79   | 74.0 | CH                  | A-7-5(28) | 3.1                         | 1.6        |
|              | C           | 4-6         | 16.8                 |                   |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | D           | 6-8         | 17.3                 | 111               |                               |    |    |      |                            |     |     |      |      |                     |           | 4.1                         | 3.3        |
|              | E           | 8-10        | 18.3                 |                   | 52                            | 25 | 27 |      |                            |     |     |      |      |                     |           |                             |            |
|              | F           | 10-11.5     | 19.1                 | 114               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | G           | 15-16.5     | 16.1                 | 116               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | H           | 20-21.5     | 22.8                 | 102               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |
|              | I           | 25-26.5     | 20.6                 | 105               |                               |    |    |      |                            |     |     |      |      |                     |           |                             |            |





## GEOTECHNICAL SERVICES

Page 4 of 4

## SUMMARY OF LABORATORY TEST RESULTS

Client: Burns & McDonnell Engineering Co., Inc Date: April 1, 2009

Project: Central Issue Facility, Lawton, Oklahoma Project No.: 7309-3055

| Boring No.     | Sample I.D. | Depth (ft.) | Moisture Content (%) | Dry Density (pcf) | Atterberg Limits (% Moisture) |    |    | Sieve Analysis (% Passing) |     |     |     |      | Soil Classification |      | Unconfined Compression Test |              |            |
|----------------|-------------|-------------|----------------------|-------------------|-------------------------------|----|----|----------------------------|-----|-----|-----|------|---------------------|------|-----------------------------|--------------|------------|
|                |             |             |                      |                   | LL                            | PL | PI | 3/8"                       | #4  | #10 | #40 | #100 | #200                | USCS | AASHTO                      | Stress (tsf) | Strain (%) |
| BH-9 (cont.)   | J           | 30-31.5     | 22.1                 | 100               |                               |    |    |                            |     |     |     |      |                     |      |                             |              |            |
|                | K           | 35-36.5     | 22.2                 | 104               |                               |    |    |                            |     |     |     |      |                     |      |                             |              |            |
|                | L           | 40-40.5     | 14.1                 | 117               |                               |    |    |                            |     |     |     |      |                     |      |                             |              |            |
|                | M           | 45-45.5     | 12.2                 | 124               | 40                            | 20 | 20 |                            |     |     |     |      |                     |      |                             |              |            |
|                | Rock Core   | 46-46.4     | 12.4                 | 128               |                               |    |    |                            |     |     |     |      |                     |      |                             | 15.0         | 3.4        |
|                |             | 51.1-51.5   | 8.5                  | 133               |                               |    |    |                            |     |     |     |      |                     |      |                             | 72.6         | -          |
| BH-10          | F           | 10-12       | 18.3                 |                   | 68                            | 22 | 46 |                            |     |     |     |      |                     |      |                             |              |            |
| BH-1,2,3, 8,10 | Compo-site  | 0-6         | 16.4                 |                   | 40                            | 15 | 25 | 100                        | 100 | 100 | 84  | 68   | 61.8                | CL   | A-6(12)                     |              |            |



## GEOTECHNICAL SERVICES

**CORROSION TESTING RESULTS**

Client: Burns &amp; McDonnell Engineering Co., Inc. Date: April 1, 2009

Project: Central Issue Facility, Ft. Sill, Oklahoma Project No.: 7309-3055

| Boring No. | Sample I.D. | Depth (ft.) | Soil Description         | Resistivity (Ohms-cm) | pH  | Sulfate Content (ppm) | Chloride Content (ppm) |
|------------|-------------|-------------|--------------------------|-----------------------|-----|-----------------------|------------------------|
| BH-7       | B           | 2 - 3.5     | Brown Fat Clay with Sand | 735                   | 8.2 | 240                   | 100                    |

## STANDARD PROCTOR TEST EVALUATION

Project: Central Issue Facility  
Ft. Sill, Oklahoma

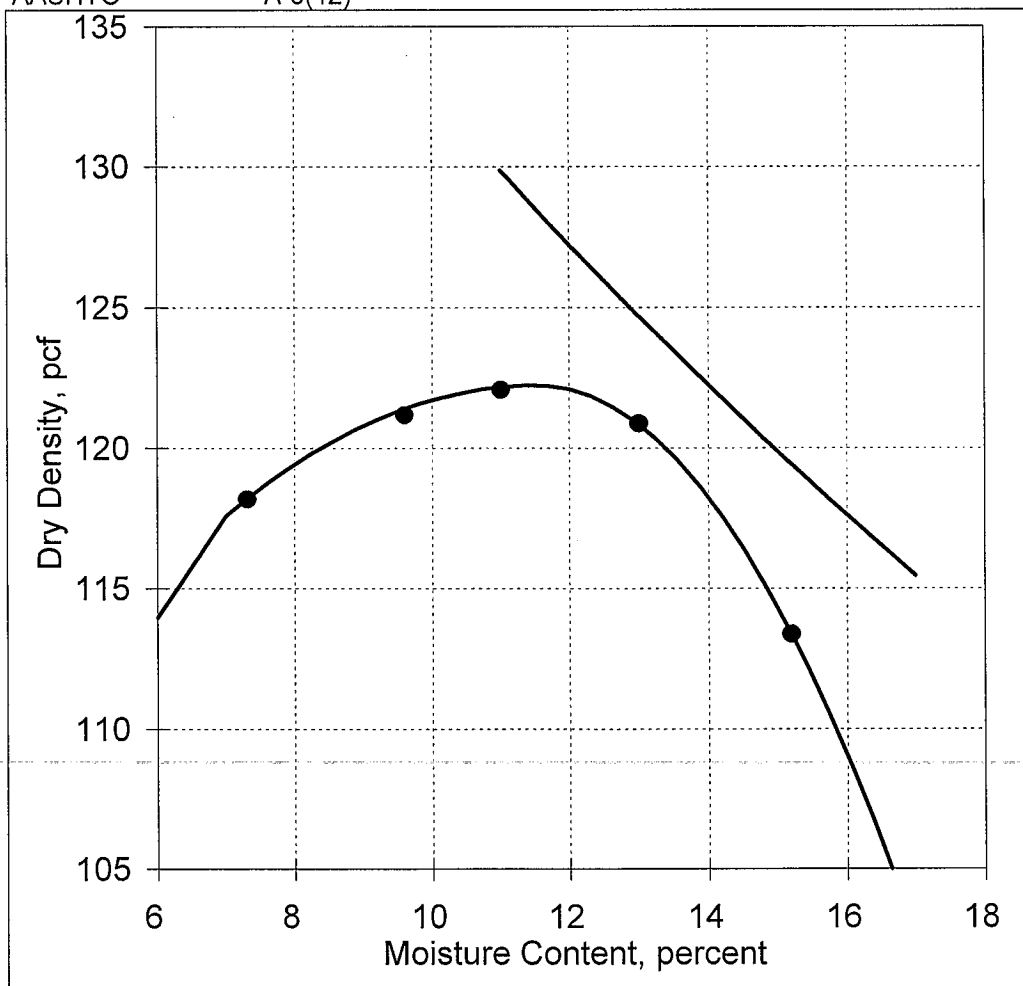
Sample: **BH-1,2,3,8,10 Composite**  
Test Method: ASTM D1557  
Project No.: 7309-3055

|                    |                  |       |       |       |       |
|--------------------|------------------|-------|-------|-------|-------|
| Test Sequence # =  | 1                | 2     | 3     | 4     | 5     |
| DD, pcf =          | 118.2            | 121.2 | 122.1 | 120.9 | 113.4 |
| M, % =             | 7.3              | 9.6   | 11.0  | 13.0  | 15.2  |
| Specific Gravity = | 2.70 (estimated) |       |       |       |       |

### Results:

|                              |                  |
|------------------------------|------------------|
| <b>Maximum Dry Density =</b> | <b>122.3 pcf</b> |
| <b>Optimum Moisture =</b>    | <b>11.5 %</b>    |

Description: Dark Brown & Brown Sandy Clay with Gravel  
Sieve= #4 #10 #40 #200  
% Passing= 100 100 84 61.8  
LL=40 PL=15 PI=20  
USCS= CL  
AASHTO= A-6(12)





## GEOTECHNICAL SERVICES

CORPORATE OFFICE and CENTRAL LABORATORY  
3400 N. Lincoln Blvd., Oklahoma City, OK 73105 (405) 528-0541  
CA77 Exp. 06/30/07

| <u>Area Offices</u>           |                  |                |
|-------------------------------|------------------|----------------|
| 5358 S. 125th E. Ave., Ste. B | Tulsa, OK 74146  | (918) 459-2700 |
| 902 Trails West Loop          | Enid, OK 73703   | (580) 237-3130 |
| 202 SE "J" Ave.               | Lawton, OK 73501 | (580) 353-0872 |

Acc. No: 0230BUR20

Project No.: 7309-3055

|                                  |   |               |               |
|----------------------------------|---|---------------|---------------|
| Report Date:                     | 04/01/09                                | Date Sampled: | 01/28/09      |
| Project:                         | Central Issue Facility                  | Sampled By:   | Johnny Jarman |
| Location:                        | Ft. Sill, Oklahoma                      | By Order Of:  |               |
| Arch./Engr.:                     |   | Order No.:    |               |
| Contractor:                      | Burns & McDonnell Engineering Co., Inc. | Quantity:     |               |
| REPORT: CALIFORNIA BEARING RATIO |   | Represented:  | Composite     |
| Specification: Project Specs.    |   | Sample No:    | BH-1,2,3,8,10 |
|                                  |   | Test Method:  | ASTM D1883    |

**TEST RESULTS**

Soil Description: Dark Brown &amp; Brown Sandy Clay

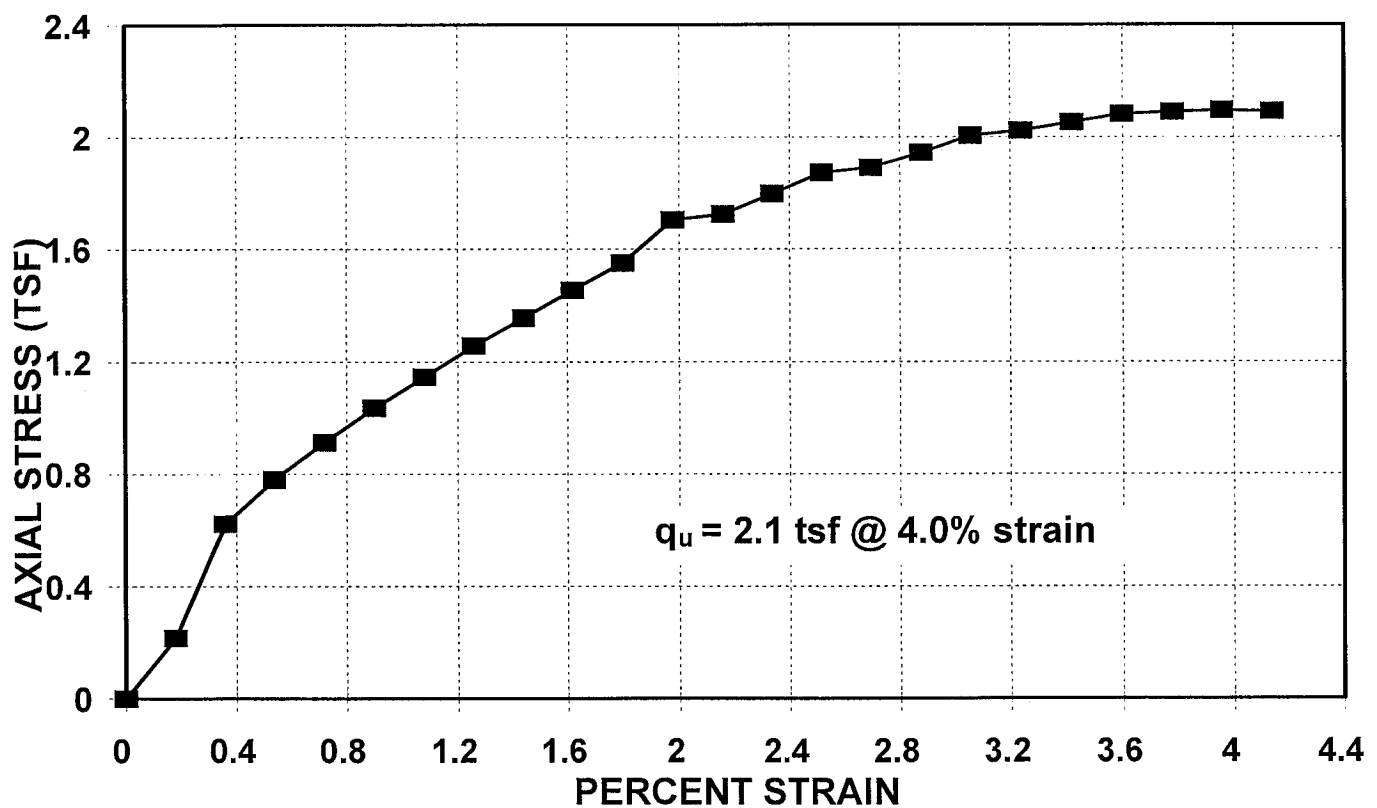
|   |       |
|---|-------|
| Density as Molded, Lbs./Cu.Ft.                  | 134.4 |
| Moisture content of Sample as Molded, Percent   | 11.8  |
| Dry Density as Molded, Lbs./Cu.Ft.              | 120.3 |
| Dry Density after Soaking, Lbs./Cu.Ft.          | 116.9 |
| Average Moisture Content after Soaking, Percent | 29.0  |
| Moisture Content in Top "1" inch, Percent       | 19.9  |
| Soaking Time, Days                              | 4.0   |
| Swell, Percent                                  | 2.9   |

| Bearing Ratio as % of Standard |                   |
|--------------------------------|-------------------|
| <u>Penetration Inches</u>      | <u>CBR Values</u> |
| 0.1                            | 4.3               |
| 0.2                            | 4.1               |
| 0.3                            | 3.7               |
| 0.4                            | 3.4               |

|                         |            |                           |            |
|-------------------------|------------|---------------------------|------------|
| Nominal CBR Value:      | 4.3        | Target Density Method:    | ASTM D1557 |
| Surcharge Weight, Lbs.: | 10.01      | Max. Density, lbs./cu.ft. | 122.1      |
| Method of Compaction:   | ASTM D1883 | Optimum Moisture, %       | 11.7       |

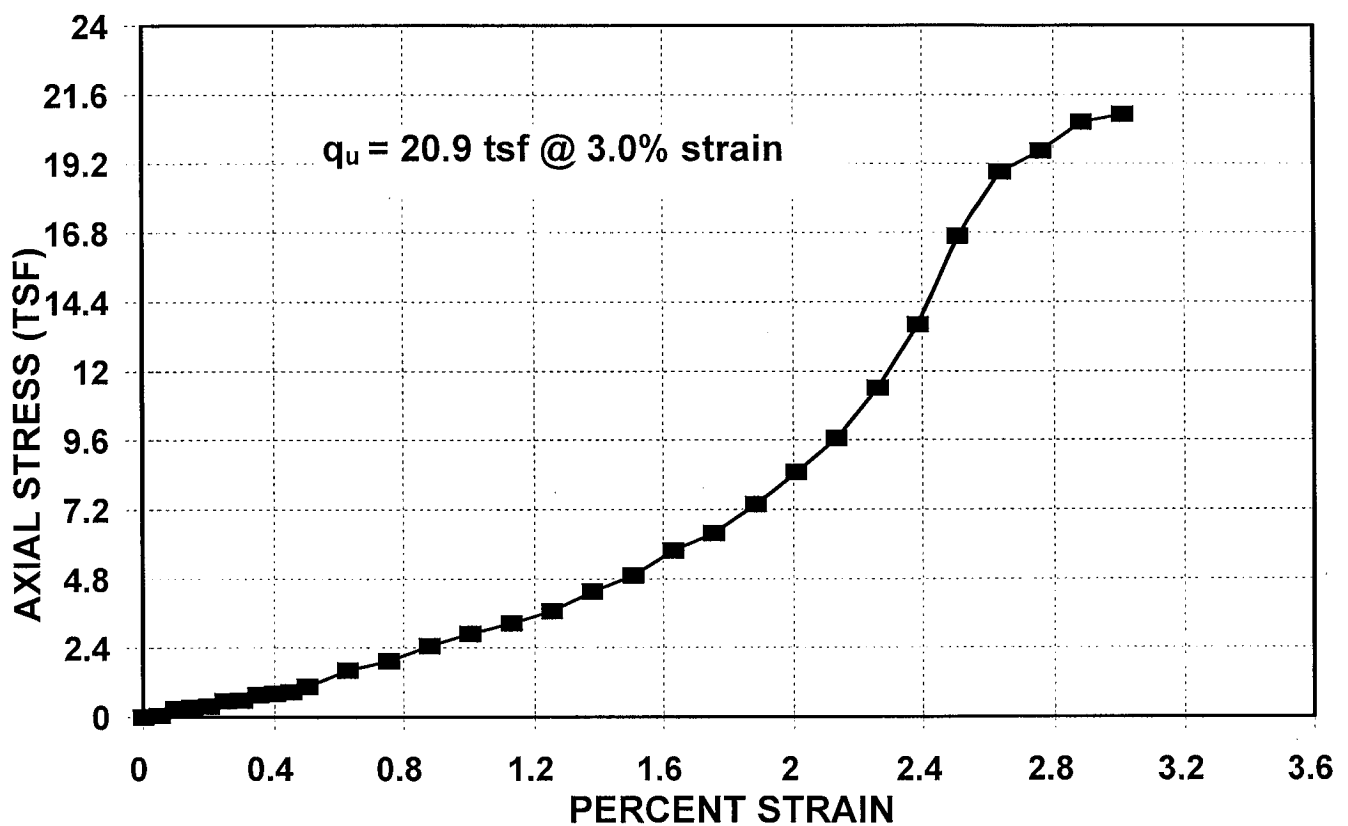
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-4, Depth: 0-2 ft.



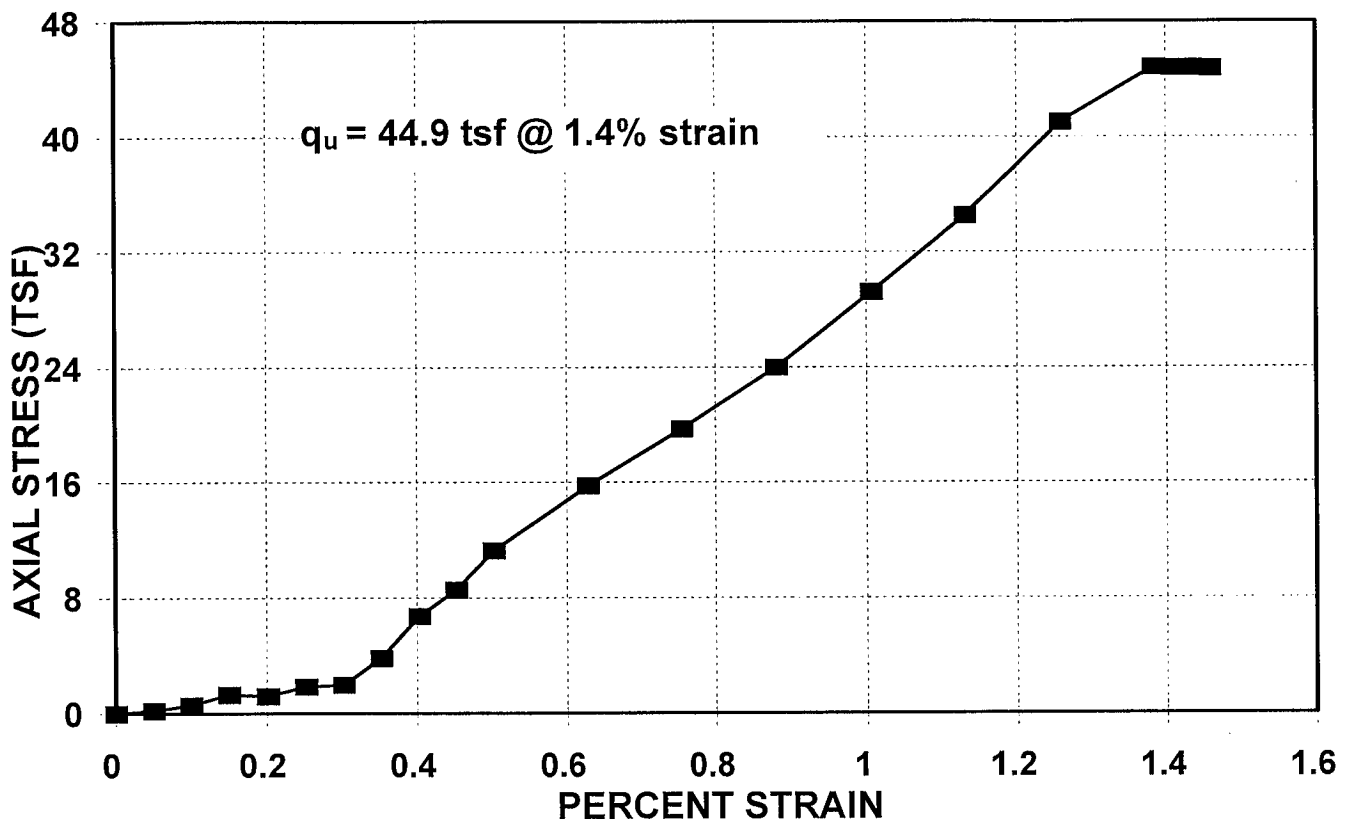
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-4, Depth: 10.8-11.2 ft.



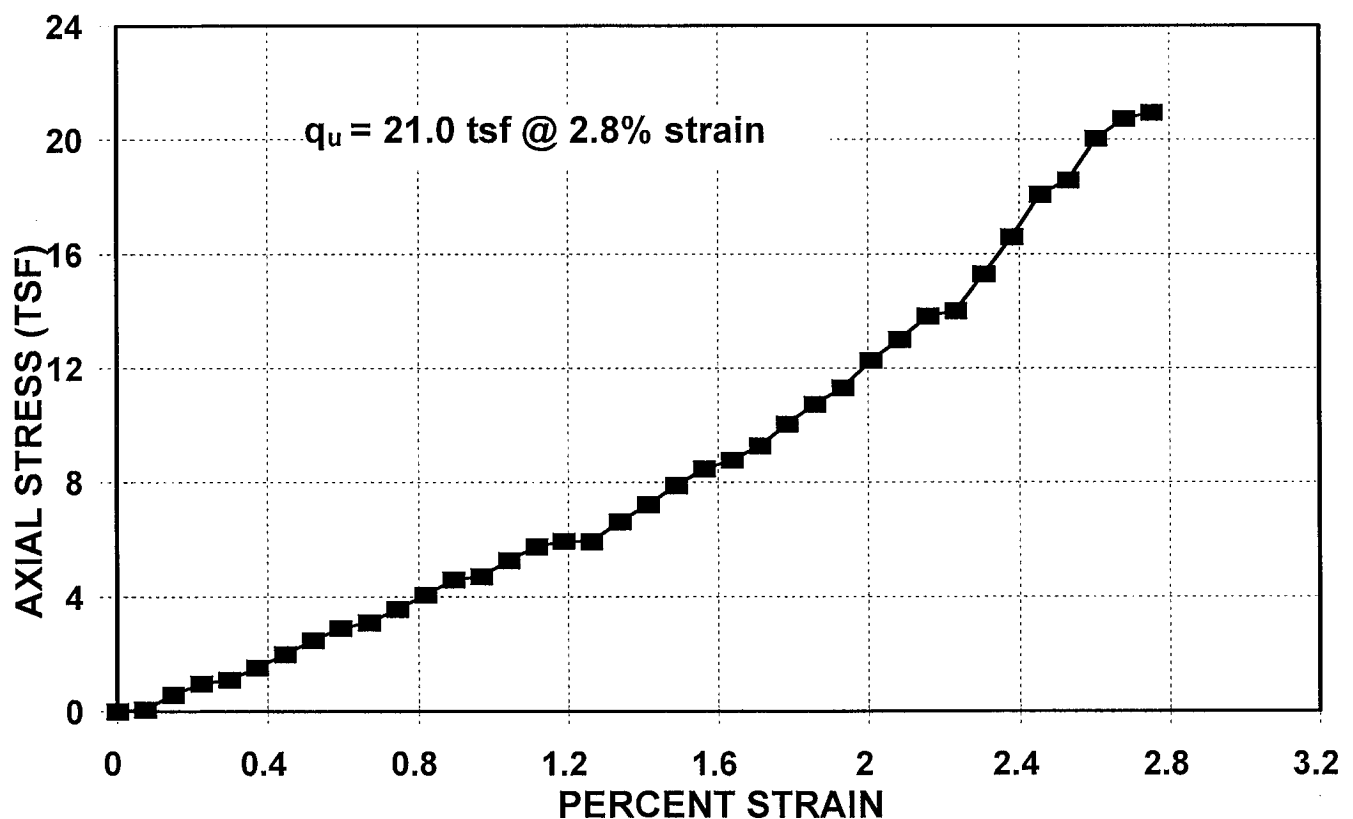
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-4, Depth: 20.5-20.9 ft.



## UNCONFINED COMPRESSION TEST

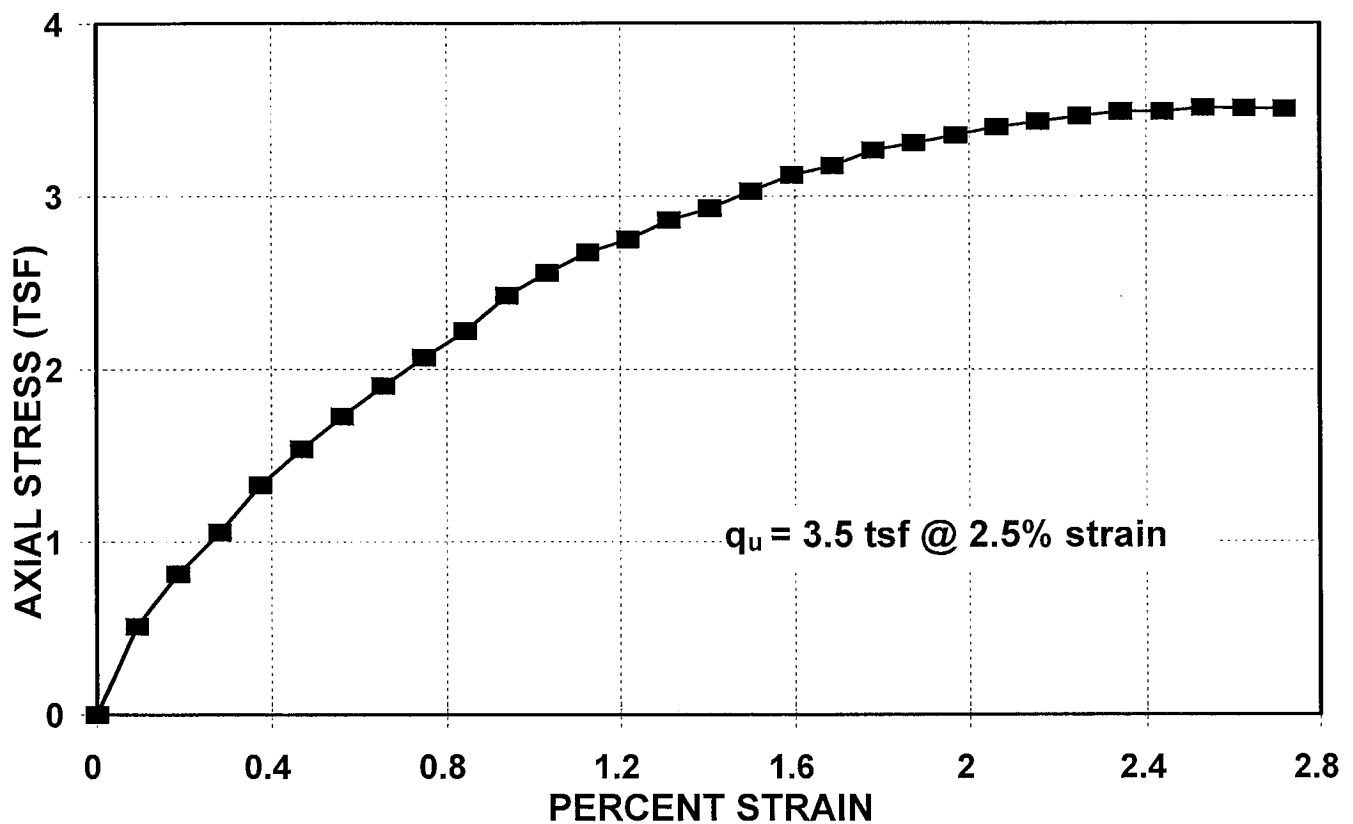
7309-3055, BH-5, Depth: 30.2-30.6 ft.





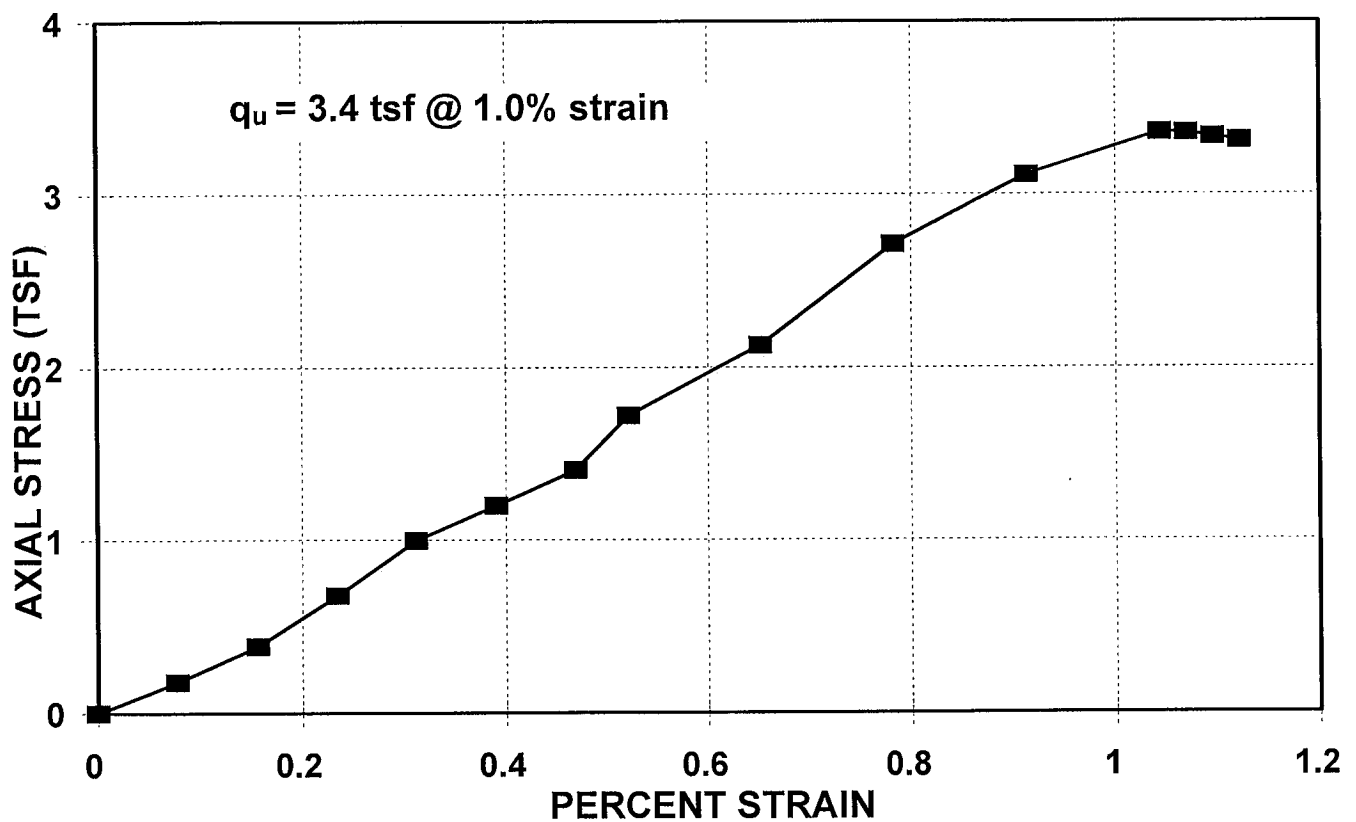
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-6, Depth: 2-4 ft.



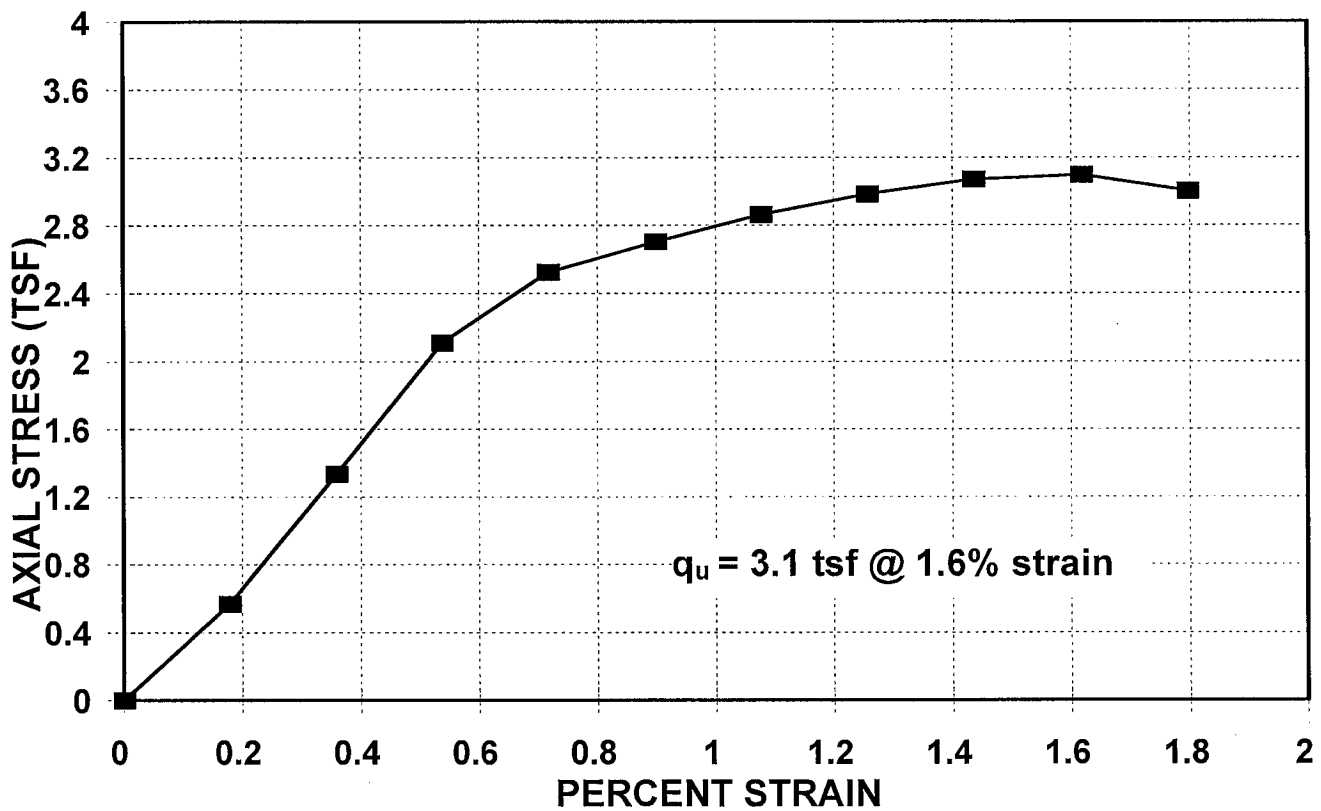
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-7, Depth: 32.4-32.8 ft.



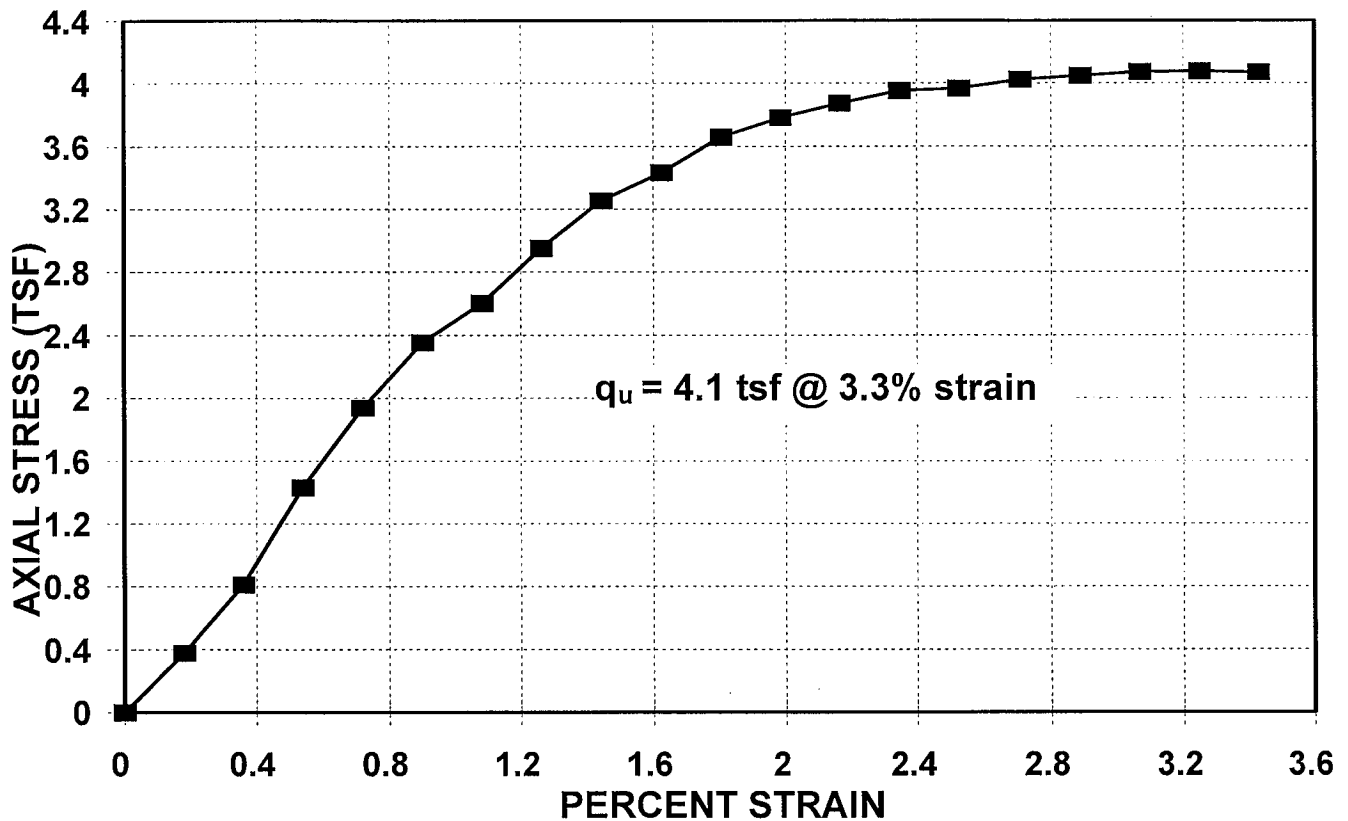
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-9, Depth: 2-4 ft.



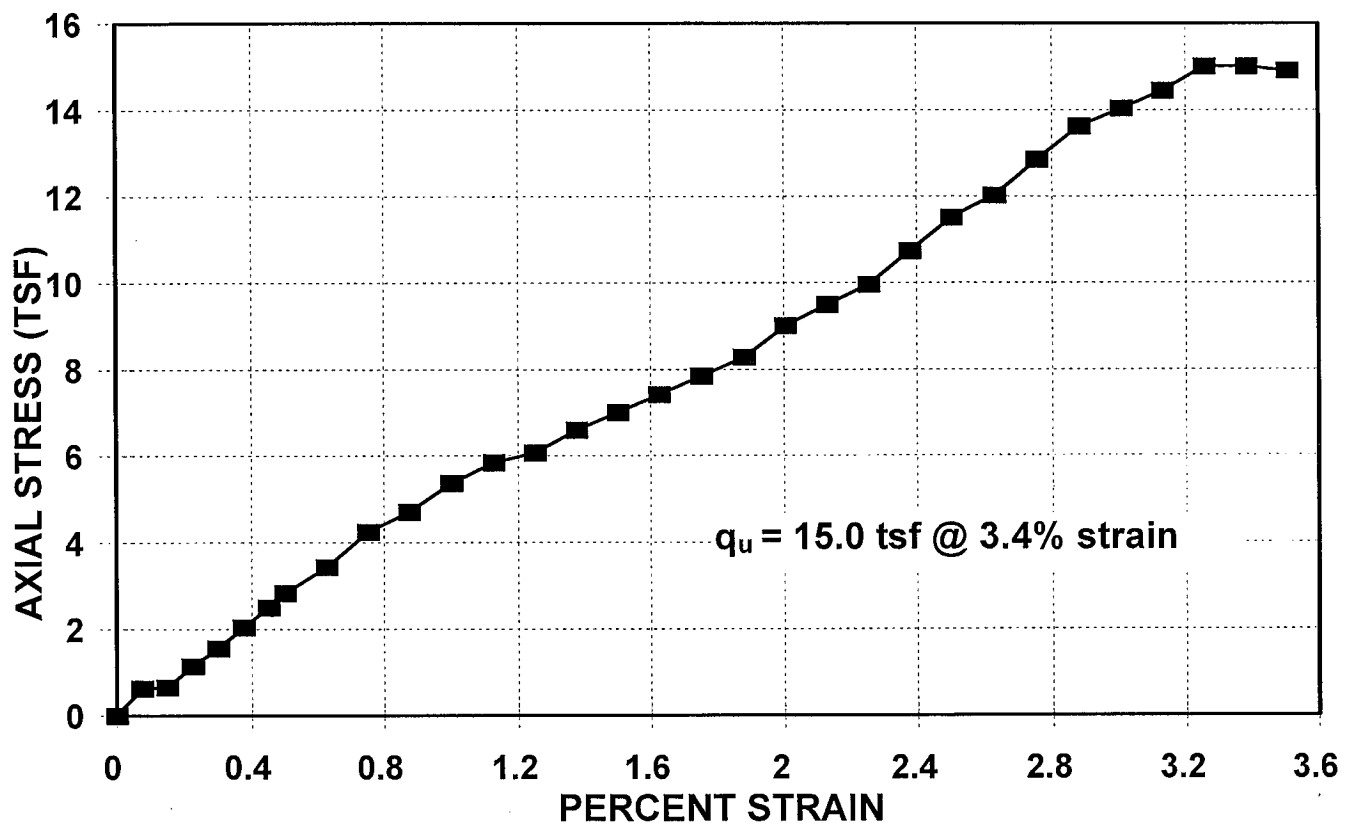
**UNCONFINED COMPRESSION TEST**

7309-3055, BH-9, Depth: 6-8 ft.



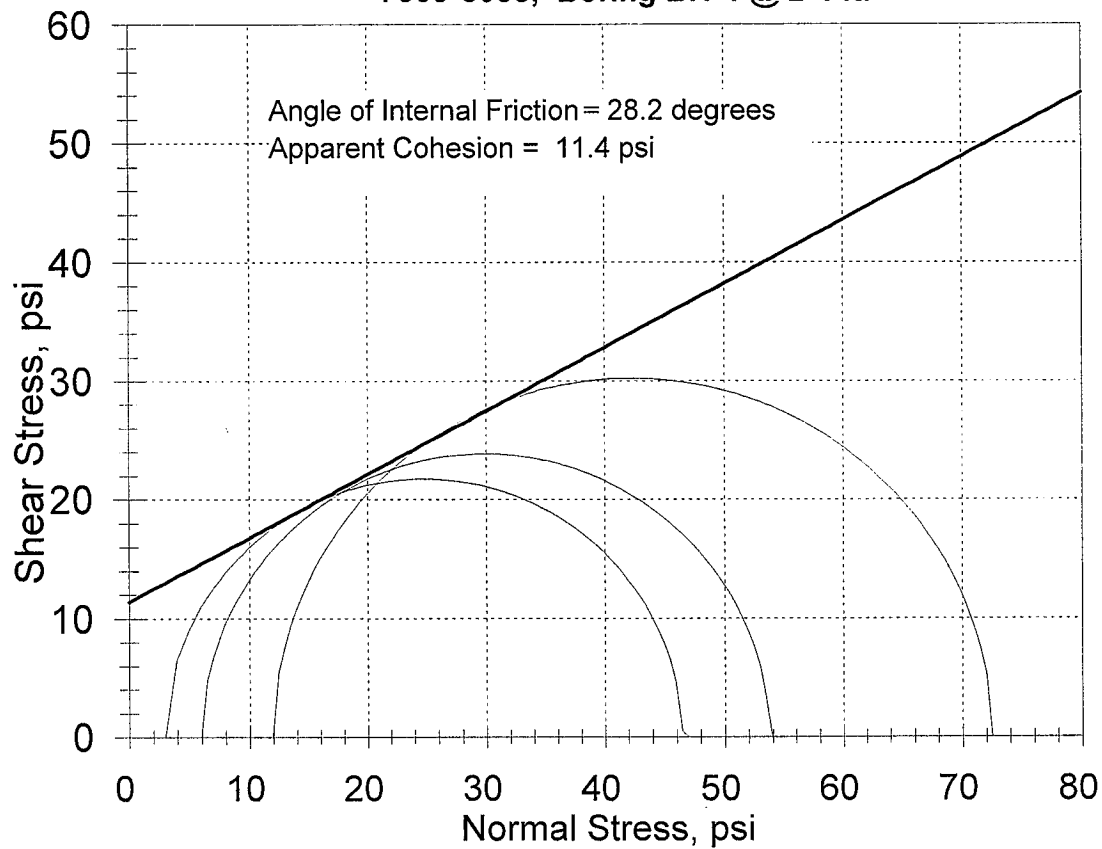
**UNCONFINED COMPRESSION TEST**

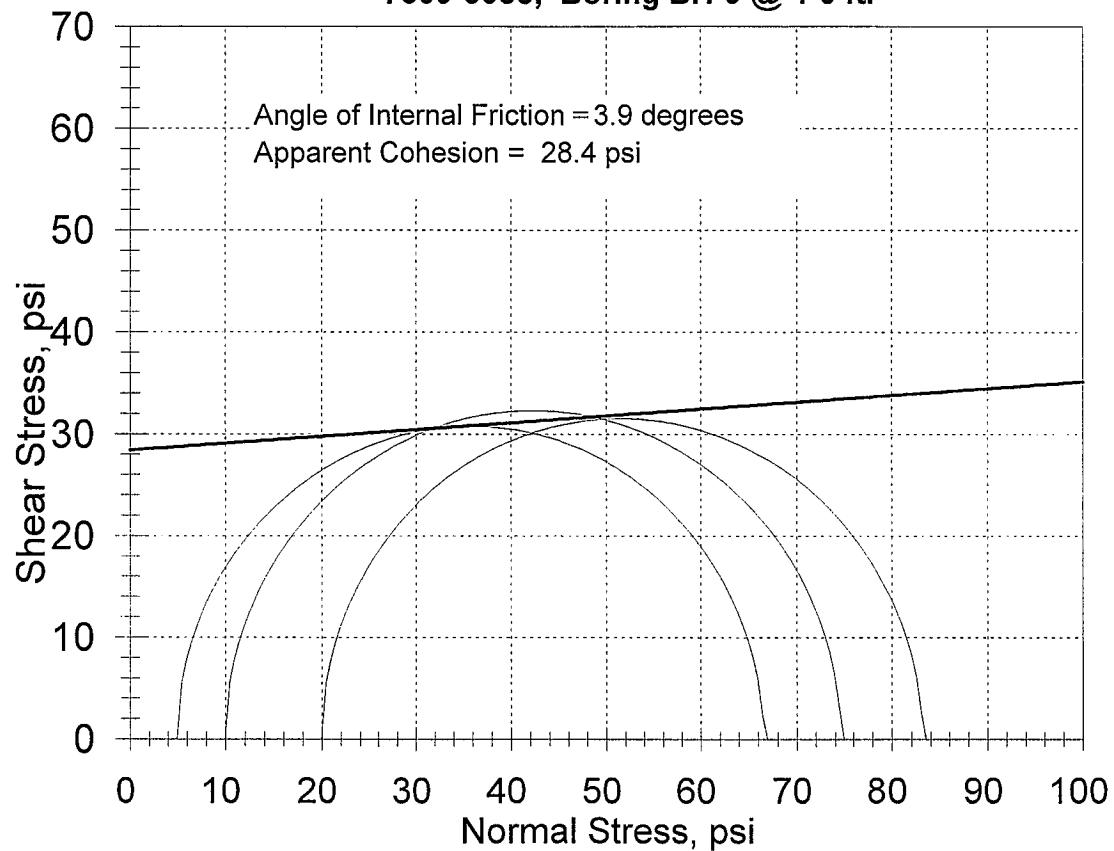
7309-3055, BH-9, Depth: 46-46.4 ft.



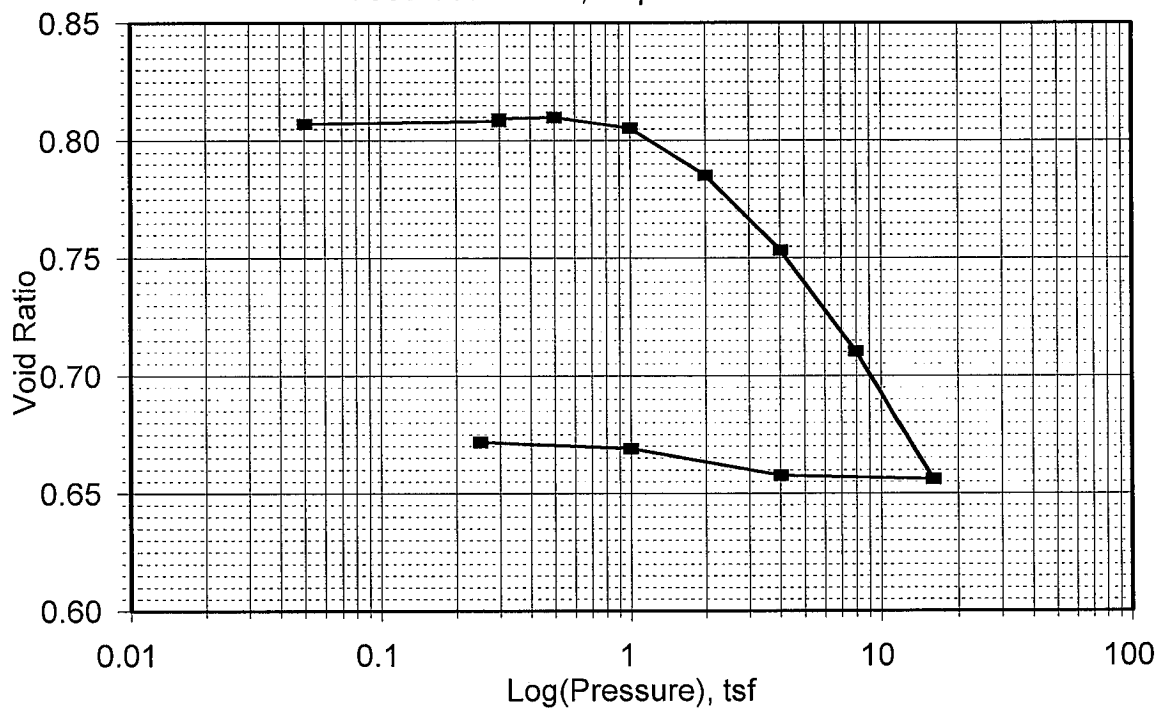
**Triaxial Compression Test Results**

7309-3055, Boring BH-4 @ 2-4 ft.

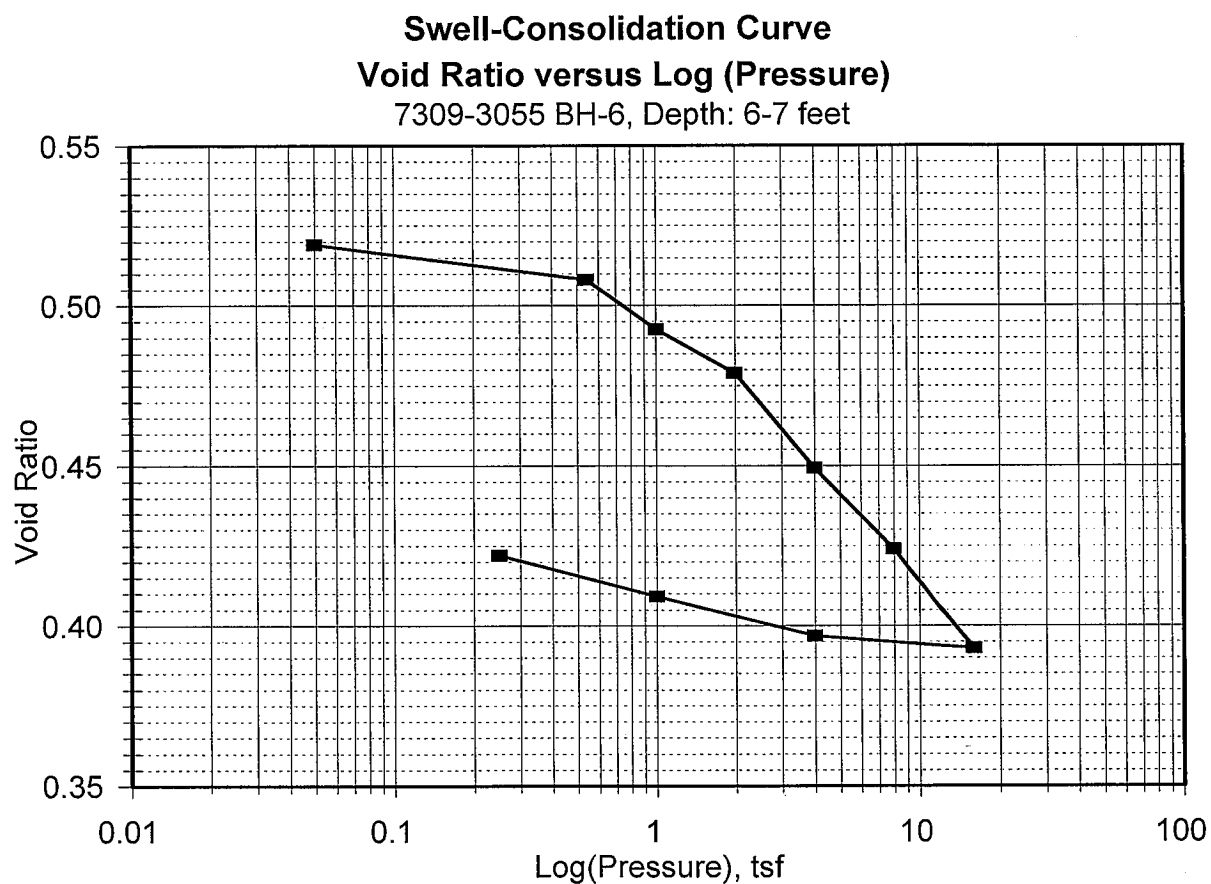


**Triaxial Compression Test Results****7309-3055, Boring BH-9 @ 4-6 ft.**

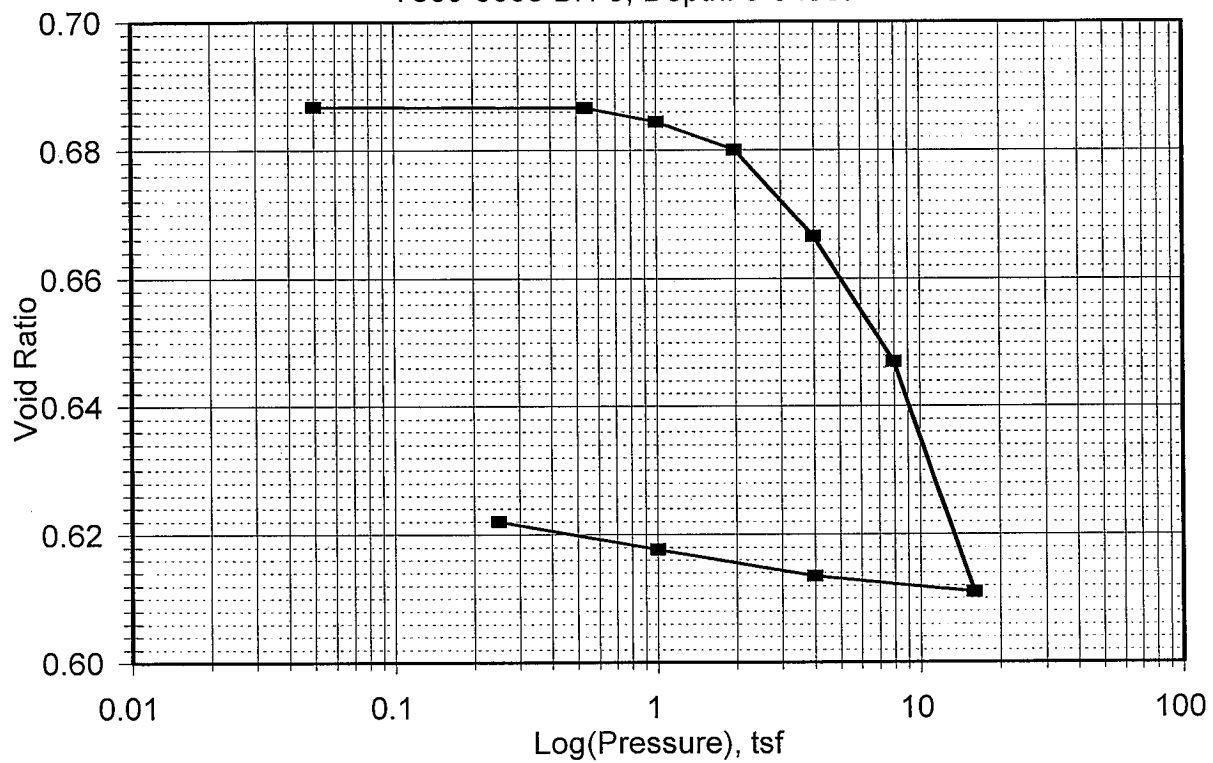
**Swell-Consolidation Curve**  
**Void Ratio versus Log (Pressure)**  
7309-3055 BH-6, Depth: 4-6 feet

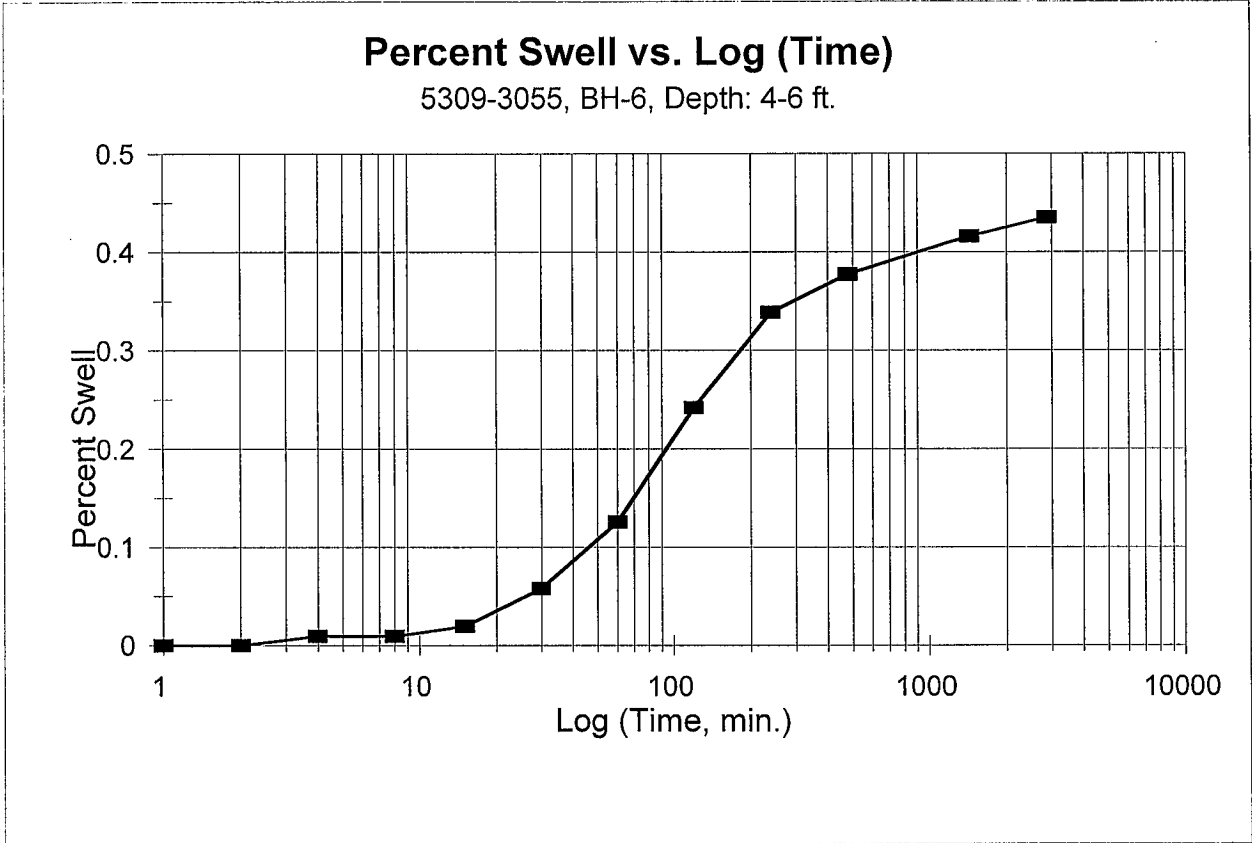


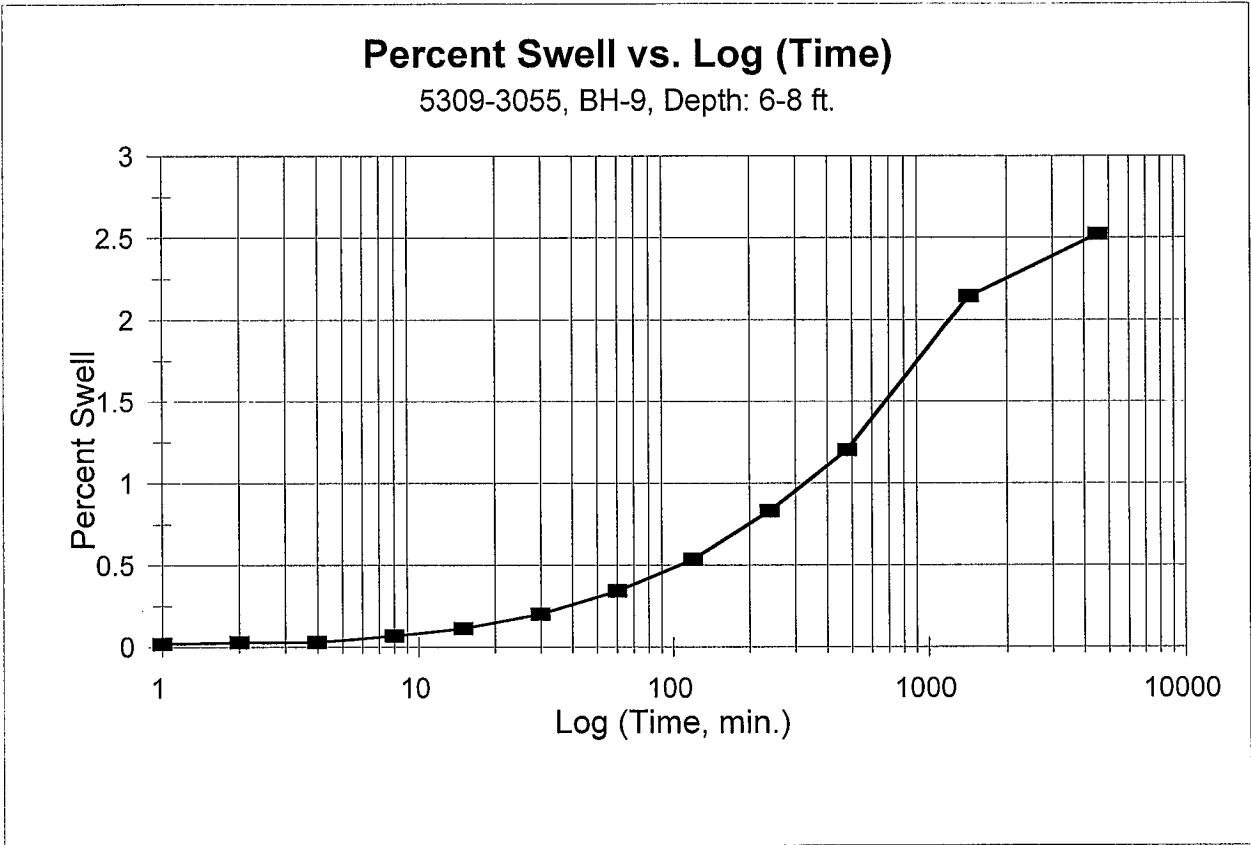




**Swell-Consolidation Curve**  
**Void Ratio versus Log (Pressure)**  
7309-3055 BH-9, Depth: 6-8 feet









GEOTECHNICAL SERVICES

**APPENDIX E**

**Analysis Results**

## Heave Calculation BH-4

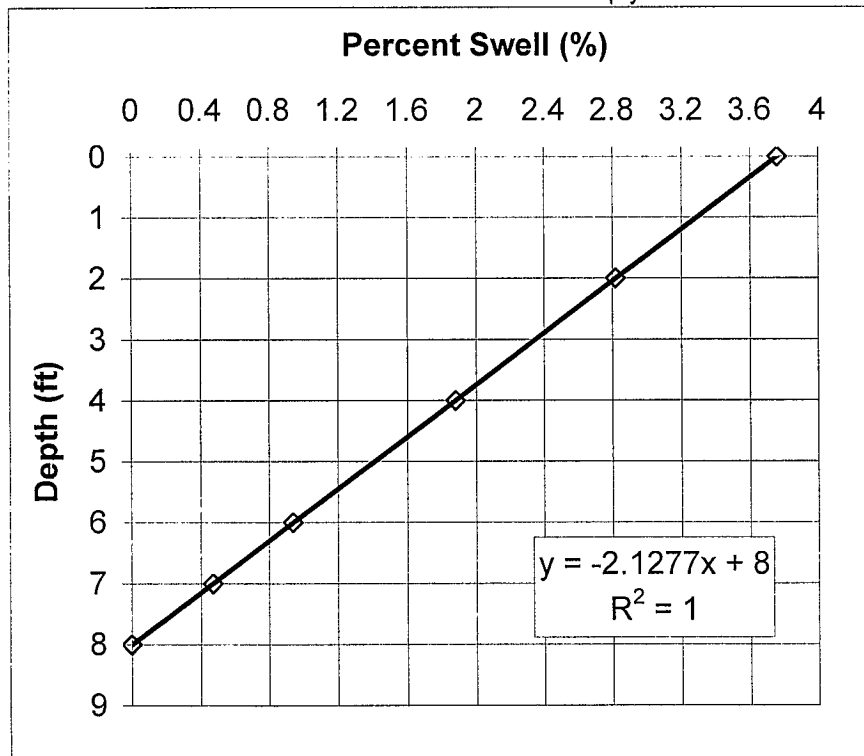
Project No.: 7309-3055  
 Project Name: Central Issue Facility  
 Project Location: Ft. Sill, Oklahoma

Boring No.: BH-6D Sample Depth: 6 - 7 ft.  
 Swell Pressure ( $P_{sp}$ , tsf) = 1.16 Calculated Heave Active Depth (ft.) = 16  
 Heave Active Depth (ft) = 8 Top of Rock & Groundwater

$e_{v0} = 0.5153$   $e_0 = 0.5082$   $P_0$  (tsf) = 0.420  
 $P_{sp} / P_0 = 2.762$   $\text{LOG} (P_{sp}/P_0) = 0.441$   
 $C_r = 0.0161$   $C_c = 0.106$

| Depth (ft) | Mid. Depth (ft) | P (tsf) | %Swell | Sample Depth (ft.) = 7 |
|------------|-----------------|---------|--------|------------------------|
| 0          | 1               | 0.072   | 3.760  | %Swell = 0.470         |
| 2          | 3               | 0.216   | 2.820  | Surface %Swell = 3.760 |
| 4          | 5               | 0.360   | 1.880  |                        |
| 6          | 6.5             | 0.468   | 0.940  |                        |
| 7          | 7.5             | 0.540   | 0.470  |                        |
| 8          | 8               | 1.160   | 0.000  |                        |

Trendline Eq.  $y = -2.1277x + 8$



$Y = 0$   
 $X = 3.760$

Total Heave

1.80 inches

## Heave Calculation BH-5

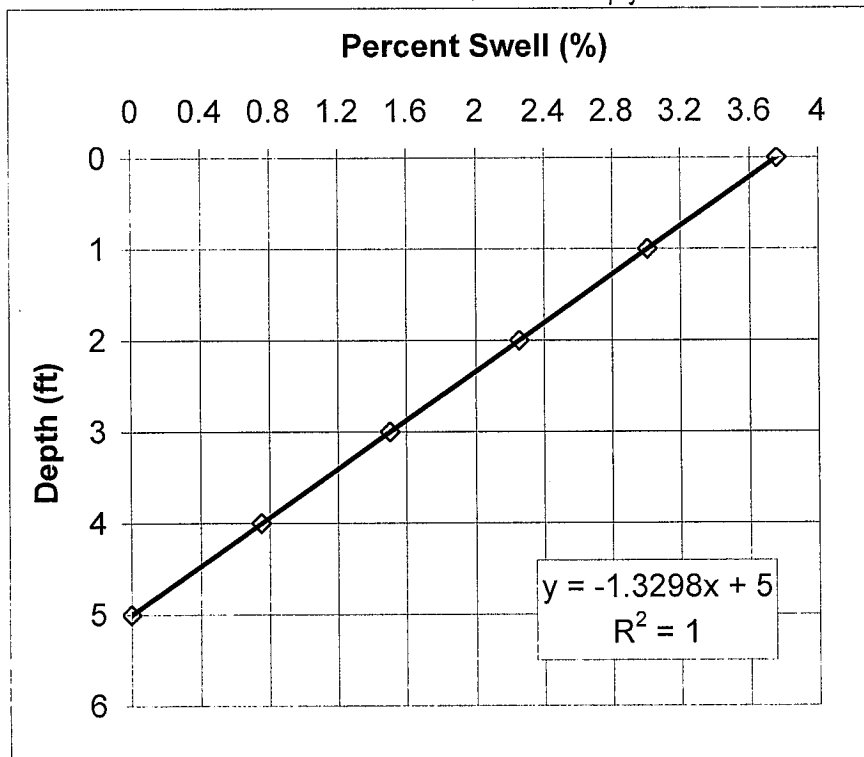
Project No.: 7309-3055  
 Project Name: Central Issue Facility  
 Project Location: Ft. Sill, Oklahoma

Boring No.: BH-6D Sample Depth: 6 - 7 ft.  
 Swell Pressure ( $P_{sp}$ , tsf) = 1.16 Calculated Heave Active Depth (ft.) = 16  
 Heave Active Depth (ft) = 5 Top of Rock

$e_{v0} = 0.5153$   $e_0 = 0.5082$   $P_0$  (tsf) = 0.420  
 $P_{sp} / P_0 = 2.762$   $\text{LOG} (P_{sp}/P_0) = 0.441$   
 $C_r = 0.0161$   $C_c = 0.106$

| Depth (ft) | Mid. Depth (ft) | P (tsf) | %Swell | Sample Depth (ft.) = 0 |
|------------|-----------------|---------|--------|------------------------|
| 0          | 0.5             | 0.036   | 3.760  | %Swell = 3.760         |
| 1          | 1.5             | 0.108   | 3.008  | Surface %Swell = 3.760 |
| 2          | 2.5             | 0.180   | 2.256  |                        |
| 3          | 3.5             | 0.252   | 1.504  |                        |
| 4          | 4.5             | 0.324   | 0.752  |                        |
| 5          | 5               | 1.160   | 0.000  |                        |
| 5          |                 |         |        |                        |

Trendline Eq.  $y = -1.3298x + 5$



$Y = 0$   
 $X = 3.760$

Total Heave

1.13 inches

## Heave Calculation BH-6

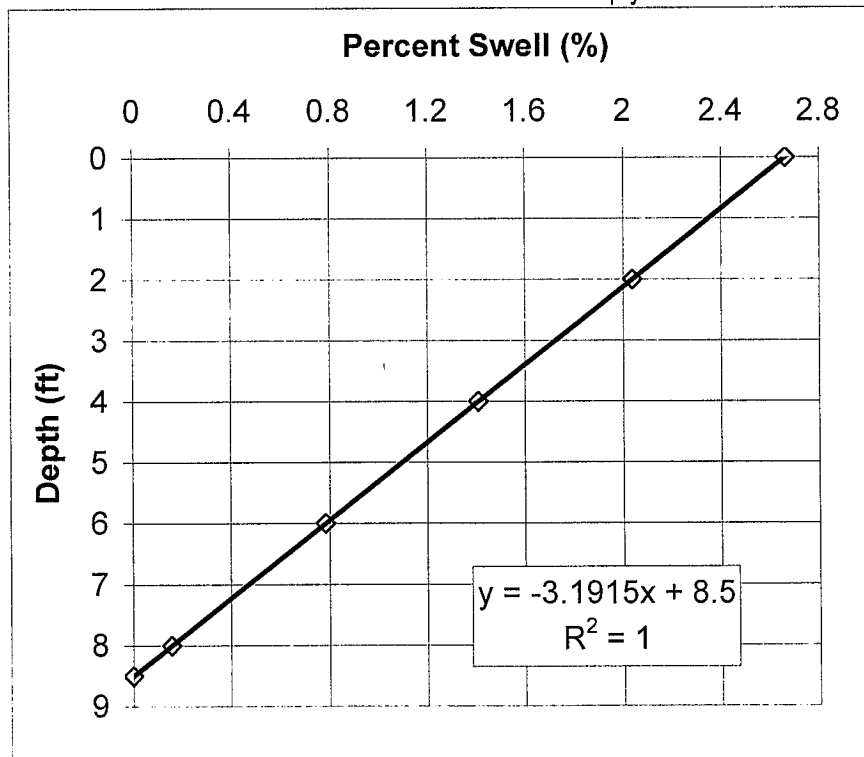
Project No.: 7309-3055  
 Project Name: Central Issue Facility  
 Project Location: Ft. Sill, Oklahoma

Boring No.: BH-6D Sample Depth: 6 - 7 ft.  
 Swell Pressure ( $P_{sp}$ , tsf) = 1.16 Calculated Heave Active Depth (ft.) = 16  
 Heave Active Depth (ft) = 8.5 Top of Rock

$e_{v0} = 0.5153$   $e_0 = 0.5082$   $P_0$  (tsf) = 0.420  
 $P_{sp} / P_0 = 2.762$   $\text{LOG} (P_{sp}/P_0) = 0.441$   
 $C_r = 0.0161$   $C_c = 0.106$

| Depth (ft) | Mid. Depth (ft) | P (tsf) | %Swell | Sample Depth (ft.) = 7 |
|------------|-----------------|---------|--------|------------------------|
| 0          | 1               | 0.072   | 2.663  | %Swell = 0.470         |
| 2          | 3               | 0.216   | 2.037  | Surface %Swell = 2.663 |
| 4          | 5               | 0.360   | 1.410  |                        |
| 6          | 7               | 0.504   | 0.783  |                        |
| 8          | 8.25            | 0.594   | 0.157  |                        |
| 8.5        | 8.5             | 1.160   | 0.000  |                        |
| 8.5        |                 |         |        |                        |

Trendline Eq.  $y = -3.1915x + 8.5$



$Y = 0$   
 $X = 2.663$

Total Heave

1.36 inches



## Heave Calculation BH-7

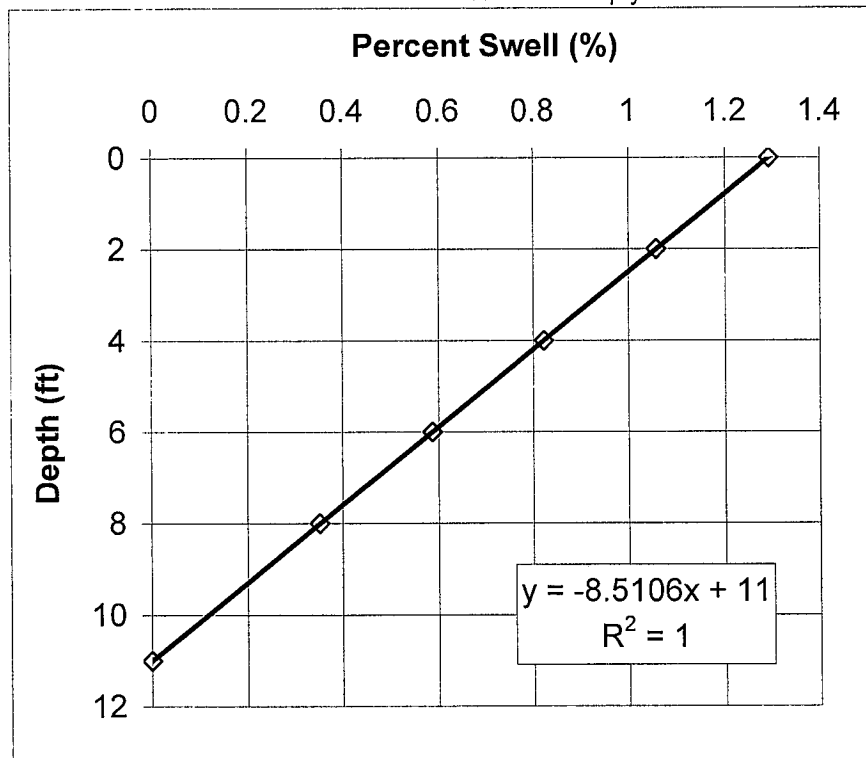
Project No.: 7309-3055  
 Project Name: Central Issue Facility  
 Project Location: Ft. Sill, Oklahoma

Boring No.: BH-6D Sample Depth: 6 - 7 ft.  
 Swell Pressure ( $P_{sp}$ , tsf) = 1.16 Calculated Heave Active Depth (ft.) = 16  
 Heave Active Depth (ft) = 11 Top of Rock

$e_{v0} = 0.5153$   $e_0 = 0.5082$   $P_0$  (tsf) = 0.420  
 $P_{sp} / P_0 = 2.762$   $\text{LOG} (P_{sp}/P_0) = 0.441$   
 $C_r = 0.0161$   $C_c = 0.106$

| Depth (ft) | Mid. Depth (ft) | P (tsf) | %Swell | Sample Depth (ft.) = 7 |
|------------|-----------------|---------|--------|------------------------|
| 0          | 1               | 0.072   | 1.293  | %Swell = 0.470         |
| 2          | 3               | 0.216   | 1.058  | Surface %Swell = 1.293 |
| 4          | 5               | 0.360   | 0.823  |                        |
| 6          | 7               | 0.504   | 0.588  |                        |
| 8          | 9.5             | 0.684   | 0.353  |                        |
| 11         | 11              | 1.160   | 0.000  |                        |
| 11         |                 |         |        |                        |

Trendline Eq.  $y = -8.5106x + 11$



$Y = 0$   
 $X = 1.293$

Total Heave

0.85 inches

## Heave Calculation BH-9

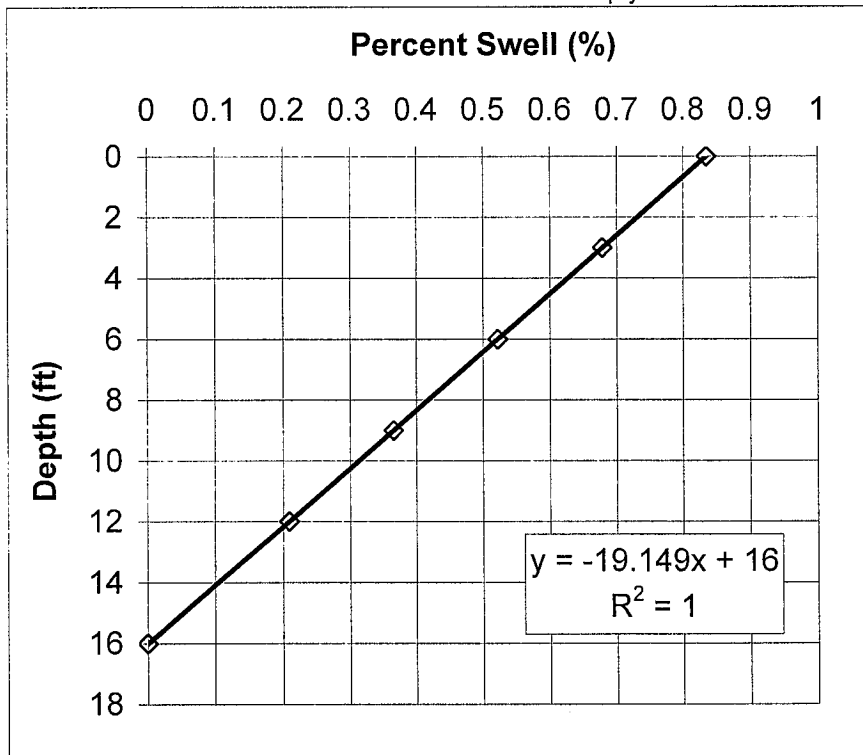
Project No.: 7309-3055  
 Project Name: Central Issue Facility  
 Project Location: Ft. Sill, Oklahoma

Boring No.: BH-6D Sample Depth: 6 - 7 ft.  
 Swell Pressure ( $P_{sp}$ , tsf) = 1.16 Calculated Heave Active Depth (ft.) = 16  
 Heave Active Depth (ft) = 16 Potential Heave Active Depth

$e_{v0} = 0.5153$   $e_0 = 0.5082$   $P_0$  (tsf) = 0.420  
 $P_{sp} / P_0 = 2.762$   $\text{LOG} (P_{sp}/P_0) = 0.441$   
 $C_r = 0.0161$   $C_c = 0.106$

| Depth (ft) | Mid. Depth (ft) | P (tsf) | %Swell | Sample Depth (ft.) = 7 |
|------------|-----------------|---------|--------|------------------------|
| 0          | 1.5             | 0.108   | 0.836  | %Swell = 0.470         |
| 3          | 4.5             | 0.324   | 0.679  | Surface %Swell = 0.836 |
| 6          | 7.5             | 0.540   | 0.522  |                        |
| 9          | 10.5            | 0.756   | 0.366  |                        |
| 12         | 14              | 1.008   | 0.209  |                        |
| 16         | 16              | 1.160   | 0.000  |                        |
| 16         |                 |         |        |                        |

Trendline Eq.  $y = -19.149x + 16$



$Y = 0$   
 $X = 0.836$   
Total Heave  
 0.80 inches

APPENDIX B  
List of Drawings

Not Used

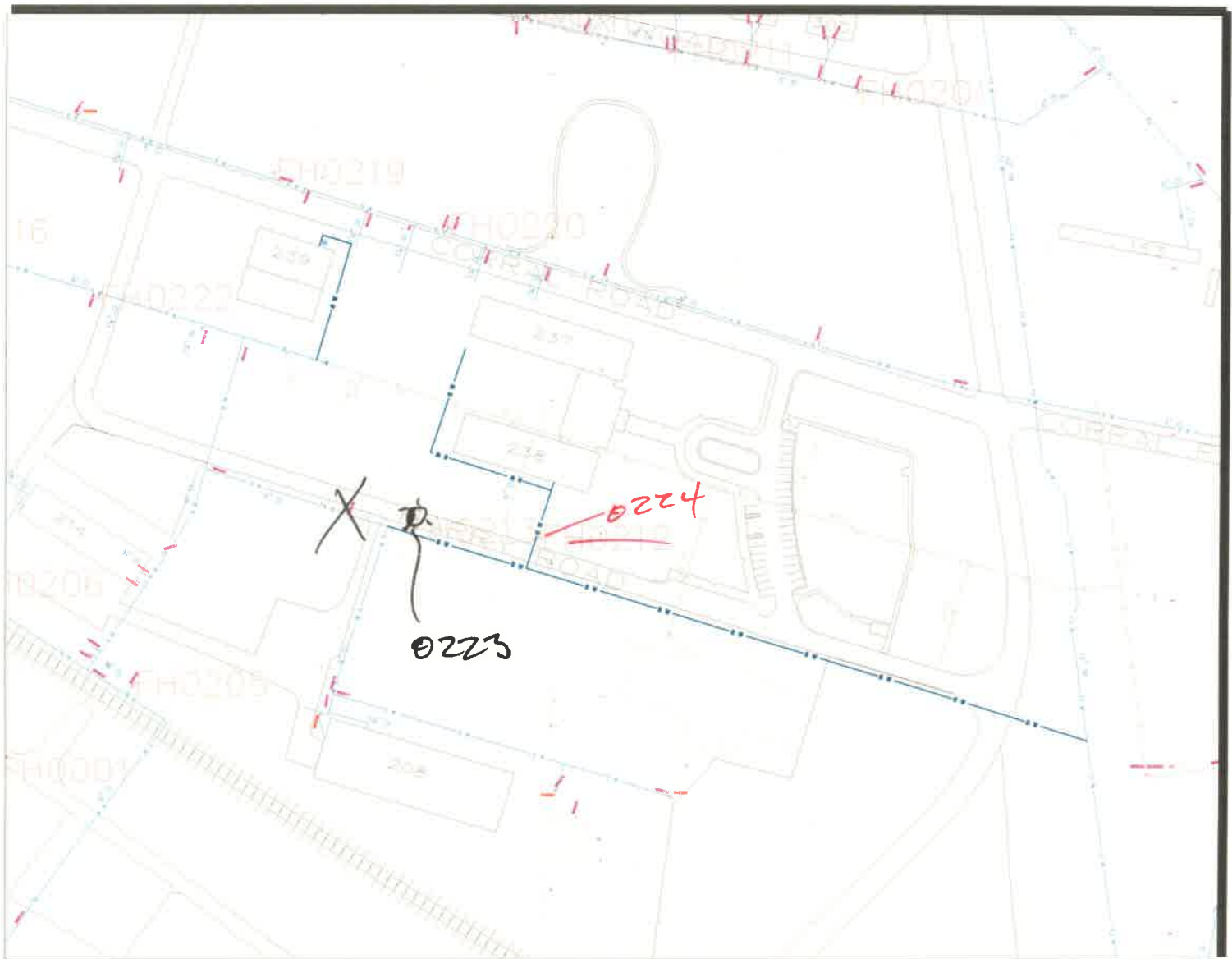
## APPENDIX C Utility Connections

Not Used

## **Appendix D**

### **Fire Flow Test**

**Currently there are no connection points or fire hydrants available in this area. The Hydrant Flow Data provided should be considered estimated flow only.**



## LOCATION

FLOW HYDRANT: 0223RESIDUAL HYDRANT: 0224DATE: 19 Jan 09TIME: 2:50ZONE: low \*TANK LEVEL IN ZONE: FF

\* NOTE: WT0328 IS OFFLINE READING AT FLOW HYDRANT  
FOR PAINTING

FLOW (GPM): 1300  
MARK PITOT READING >>>

READING AT RESIDUAL HYDRANT

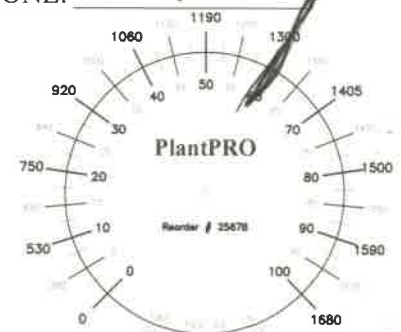
STATIC PRESSURE (PSI): 70RESIDUAL PRESSURE (PSI): 62

FIGURE NO.:

|       |             |             |
|-------|-------------|-------------|
| ITEMS | PLOT DATE   | DRAWN BY    |
|       | 1/19/09     | TRB         |
|       | SCALE       | CHECKED BY  |
|       | 1" = 100'   | TRB         |
|       | DESIGNED BY | PROJECT NO. |
|       | TRB         | TRB         |

FORT SILL  
Fire Hydrant Flow Test



AMERICAN WATER  
MILITARY SERVICES GROUP  
FORT SILL, OKLAHOMA

Building 5925  
Wastewater Treatment Plant  
P.O. Box 33178  
Fort Sill, Oklahoma 73503  
Phone: (505) 248-1918  
Fax: (505) 248-1918

Friday, February 18, 2011

## **Appendix E**

### **Environmental Information**

***Draft Finding of No Significant Impact  
Base Realignment at Fort Sill, Oklahoma***

Pursuant to the Council on Environmental Quality (CEQ) Regulations (Title 40 of the *Code of Federal Regulations* [CFR] Parts 1500–1508) for implementing the procedural provisions of the National Environmental Policy Act (Title 42 of the *United States Code*, Part 4321 et seq.) and Army regulation (32 CFR Part 651), Fort Sill, Oklahoma, conducted an Environmental Assessment (EA) of the potential environmental and socioeconomic effects associated with implementing the Base Realignment and Closure (BRAC) Commission’s recommendations at the installation.

**PROPOSED ACTION**

The BRAC Commission made six recommendations concerning Fort Sill.

- *Operational Army.* Air Defense Artillery (ADA) units at Fort Bliss, Texas, are to be relocated to Fort Sill, and an artillery brigade at Fort Sill is to be relocated to Fort Bliss.
- *Transformation of the Reserve Component in Oklahoma.* The Keathley and Burris U.S. Army Reserve Centers in Lawton and Chickasha, Oklahoma; the Wichita Falls U.S. Army Reserve Center in Wichita Falls, Texas; the 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup>, and 6<sup>th</sup> U.S. Army Reserve Centers; and Equipment Concentration Site located on Fort Sill, Oklahoma, are to be closed. The units at those locations are to be relocated into a new Armed Forces Reserve Center on Fort Sill, and a new U.S. Army Reserve Equipment Concentration Site is to be collocated with the Oklahoma Army National Guard Maneuver Area Training Equipment Site on Fort Sill.
- *Command and control of the U.S. Army Reserve in the southwestern United States.* The Major General Harry Twaddle U.S. Armed Forces Reserve Center, Oklahoma City, Oklahoma, is to be closed, and the 95<sup>th</sup> Division (Institutional Training) is to be relocated to Fort Sill.
- *Net Fires Center.* The ADA Center and School at Fort Bliss, Texas, is to be relocated to Fort Sill, and that organization is to consolidate with the Field Artillery Center and School to establish a Net Fires Center at Fort Sill.
- *Consolidation of correctional facilities.* Lackland Air Force Base, Texas, Fort Knox, Kentucky, and Fort Sill are to be realigned by relocating the correctional function of each to Fort Leavenworth, Kansas, to form a single Midwest Joint Regional Correctional Facility.
- *Defense Finance and Accounting Service.* Twenty-one Defense Finance and Accounting Service nationwide sites, including the one at Fort Sill, are to be closed. The functions are to be relocated and consolidated in Ohio, Colorado, or Indiana.

Implementation of the proposed action would require renovation of existing facilities and construction of new facilities to accommodate the increase in personnel and functions assigned to Fort Sill. The proposed new buildings would provide more than 2 million square feet of space. Assignment of additional personnel to Fort Sill would require the post’s adding several ranges to its current inventory of training resources, including a Military Operations of Urban Terrain Site, a Basic 25-meter Zero Range, an Automated Record Fire Range, a Night Infiltration Course, a Fire and Movement Range, a Squad Defense Range, an 88M Driver Training Course, and a Fires and Movement Range.



In addition to the BRAC-directed actions, discretionary actions would be taken to achieve optimal force structure and basing to best carry out assigned missions. Discretionary actions associated with the BRAC Commission's recommendations are: (1) Moving the German Air Force Defense School and the German Air Force Command from Fort Bliss, Texas, to Fort Sill; (2) Reconfiguring field artillery brigades into modular Fires Brigades; and (3) Relocating the Receipt in Place Location, a facility operated by the Defense Reutilization and Marketing Service for receipt of tenant organizations' excess materiel before disposition by redistribution or sale, on Fort Sill.

Under the BRAC law, the Army must initiate all realignments not later than September 14, 2007, and complete all realignments not later than September 14, 2011. Implementation of the proposed action would occur over a span of approximately 5 years. Facilities renovations and new construction would be synchronized to meet the needs, on a priority basis, of units being relocated to Fort Sill.

## **ALTERNATIVES**

Army Regulation (AR) 210-20, *Master Planning for Army Installations*, establishes Army policy to maximize use of existing facilities. Fort Sill's evaluation of its existing inventory of facilities revealed a substantial shortfall in built space to accommodate the additional personnel and equipment associated with the realignment. In a few instances, some units and functions could be assigned to existing facilities and some facilities would require renovation to adequately support new occupants, but overall the evaluation indicated that post would require more than 2 million square feet of additional space to support the proposed actions.

Determination of the locations of the new facilities and functions that would be placed in existing facilities involved consideration of compatibility between the functions to be performed and the installation's land use designation for the site, adequacy of the sites for the function, proximity to related activities, distance from incompatible activities, availability and capacity of roads, efficient use of property, development density, potential future mission requirements, and special site characteristics, including potential environmental incompatibilities. Additionally, the Army had to consider the legal requirement of completing the realignment by September 2011.

Numerous variations of the proposal for siting the facilities could have been developed, but the locations selected were found, upon consideration of the above criteria, to reflect a sound, compatible set of solutions. Alternative siting schemes would have produced different, but not better, layouts. The implementation proposed in the EA, therefore, was the only one carried forth for analysis.

CEQ regulations require inclusion of the no action alternative. The no action alternative serves as a baseline against which the impacts of the proposed action and alternatives can be evaluated. Under the no action alternative, Fort Sill would not implement the proposed action. The BRAC recommendations have the force of law and must be implemented; the no action alternative, therefore, is not possible. Consistent with CEQ requirements, however, the no action alternative is evaluated in detail in the EA.

## ENVIRONMENTAL CONSEQUENCES

The environmental and socioeconomic consequences of implementation of the realignment alternative and the no action alternative are summarized below.

### **Realignment Alternative**

**Land Use and Airspace.** No effects on land use or airspace would be expected. With only minor exception, the realignment plan was found to be compatible with existing land uses in the cantonment area. One of the BRAC parcels borders the Henry Post Army Airfield, but the analysis determined that a land use incompatibility due to noise from the airfield would not be created.

**Aesthetics and Visual Resources.** Short-term minor adverse consequences on aesthetics and visual resources would be expected from the increase of construction activities, which are inherently aesthetically displeasing. In the long term, new and renovated facilities would be expected to improve the functionality of the cantonment area and improve the area's overall aesthetic and visual appeal.

**Air Quality.** Short-term and long-term minor adverse effects on air quality would be expected. Emissions associated with construction and operation of facilities, however, would not exceed *de minimis* thresholds, be "regionally significant," contribute to a violation of any federal, state, or local air regulation, or contribute to a violation of Fort Sills air operating permit.

**Noise.** Short- and long-term minor effects on the noise environment would be expected. A short-term increase in on-post noise would result from the use of heavy construction equipment, and a long-term increase in noise would result from the use of weapons up to and including 5.56-caliber rifles at the proposed 25-meter Zero Range. All on- and off-installation areas would be compatible with the expected changes to the noise environment.

**Geology and Soils.** No effects on geology, seismicity, topography, or Prime Farmlands would be expected. Long- and short-term minor adverse effects on soils would be expected from construction activities.

**Water Resources.** Short-term minor adverse effects on surface waters and groundwaters would be expected. Construction activities would increase soil disturbance and potentially soil erosion, and total suspended solids could thus be increased in nearby waters. Also, leakage from construction equipment could increase petroleum hydrocarbon pollution in surface waters. Waterborne contaminants contributed by construction activities could be transported into the groundwater system, though the BRAC action would not change the long-term quantity or quality of groundwater. No effects on floodplains would be expected: There are no 100-year floodplains within the proposed impact areas.

**Biological Resources.** Short- and long-term minor adverse effects on vegetation and wildlife would be expected. Construction activities would cause the loss of small areas of native and non-native vegetation, but disturbed areas would be revegetated with native species. Construction activities would also cause losses of habitat at construction sites. Most effects on wildlife would result from their displacement because of being disturbed by construction activities. There would be no effect on threatened, endangered, or other species of concern, or wetlands: All known habitats for sensitive species would be avoided, and no wetlands are located in the proposed areas.

**Cultural Resources.** No effects on cultural resources would be expected. The potential for impacts on unknown cultural and historical resources is always present, but adherence to policies and guidelines in Fort Sill's Integrated Cultural Resources Management Plan and consultation with the State Historic Preservation Officer would be conducted as necessary to avoid potential adverse effects.

**Socioeconomics.** Short- and long-term beneficial effects on economic development would be expected. The expenditures associated with renovation and construction of facilities on Fort Sill would increase sales volume, employment, and income in the region of influence (ROI). Short-term minor adverse effects on housing and all services would be expected from an increased demand for and reduced availability of housing and services in the ROI, and the increase in population would create a need for additional law enforcement, fire protection, and medical services; family support and social services; and shops, other services, and recreation. In the long-term, the housing market and all services could adapt to the demands of the increased population base. Short-term moderate adverse effects on schools would be expected. The incoming population would increase the number of school children in the ROI, and the Lawton Public School District schools would have to accommodate the increased student load. No adverse effects on Environmental Justice or children would be expected, as the realignment of Fort Sill would not create disproportionately high or adverse human health or environmental effects on minority of low-income populations in the ROI, or incur environmental health risks or safety risks on children.

**Transportation.** Short-term minor adverse effects on transportation would be expected during the construction and renovation phase due to additional traffic congestion and traffic delays caused by construction activities. Wear and tear on installation roads would also likely increase.

**Utilities.** Short-term minor adverse effects on utilities would be expected from service interruptions during construction while new and renovated facilities are being hooked up to existing utilities systems. Only the electrical system, in its current configuration, would be inadequate to meet the added demand of incoming BRAC elements, and the additional demand would be met by the installation of a new 40-mega-watt sub-station.

**Hazardous and Toxic Materials.** No effects on hazardous or toxic materials or wastes would be expected. Facility renovations would adhere to local, federal, and Army regulations for the removal and disposal of hazardous materials, and new facilities would minimize the use of such materials. All materials handling, storage, and disposal would be in accordance with applicable laws and regulations.

**Cumulative Effects.** No adverse cumulative effects would be expected: No specific concurrent projects have been identified, and as such no cumulative impacts are expected.

### **No Action Alternative**

No effects on any of the resource areas considered in the EA would be expected to result from implementation of the no action alternative.

### **MITIGATION MEASURES**

The EA identifies mitigation measures for each resource area that would be undertaken to minimize adverse effects on the environment.

**CONCLUSIONS**

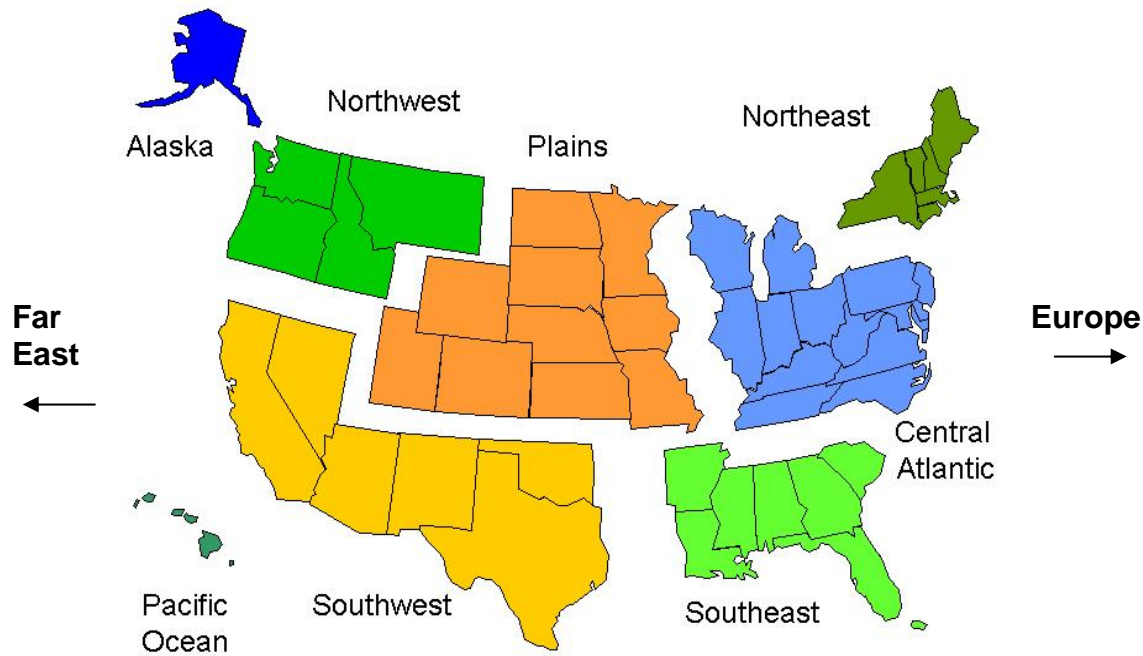
Based on the analysis performed in this EA, implementation of the realignment alternative would have no significant direct, indirect, or cumulative effects on the quality of the natural or human environment. Preparation of an Environmental Impact Statement is not required. Issuance of a Finding of No Significant Impact would be appropriate.

|   |               |
|---|---------------|
| _____<br>JOHN UBERTI<br>Colonel, FA<br>Garrison Commander | _____<br>Date |
|---|---------------|

## **Appendix F**

### **Conceptual Aesthetic Considerations**

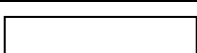
*Appendix L*  
**EXTERIOR  
COLOR  
CHARTS**



**Southwest USA**

L.1 Colors schemes and building materials are critical design elements in relating adjacent buildings and creating a compatible visual environment within an installation. This section identifies the Army standard palate of colors that will unify installations. A sufficient color palate range is provided to allow for variety. General direction on the use and application of materials and their colors follows --

- Avoid cluttered, cosmetic application of a number of different materials on a façade. Use materials consistently on all facades of a building.
- Select materials based upon their appropriateness to the building type, climatic conditions, and prevailing architectural design and landscape character of the installation.
- Utilize materials distinctive to an architectural character worthy of merit consistently throughout an installation.
- Relate buildings with compatible material and similar colors.
- Select colors for material from the Army color standard on the basis of the desired appearance, function, attractiveness of the building, and its compatibility with adjacent building colors.
- Limit exterior building colors to the Army established color palette. This provides each area a coordinated palette of similar colors that are subdued and harmonious. Avoid strong, loud colors.

| <div> <div>EXTERIOR COLOR CHART</div> <div>Southwest USA</div> </div> |   |                               |   |                         |
|---|---|-------------------------------|---|-------------------------|
| Building Design Element   |   | Required Color Standard       | Color Sample  | Notes<br>(Hyperlinked ) |
| Walls   | Base (primary) material                               | Tan Brick or native stone     |    |                         |
|   | Secondary material                                    | Almond 5910W or Tan 23717     |    |                         |
|   |   | Mocha 20372                   |    |                         |
| Roof  | Sloped areas  | Metal Bronze or Terracotta    |    |                         |
|   |   | Clay Terracotta               |    |                         |
|   |   | Fiberglass Shingle Gray/White |    |                         |
|   | “Flat” areas  | White                         |    |                         |
| Fenestration  | Doors   | Wood: White 5770W             |    |                         |
|   |   | Steel: Dark Brown 5225N       |  |                         |
|   | Storm Doors   | White                         |  |                         |
|   | Door & Window Frames                                  | Brown 20313                   |  |                         |
|   | Storm window or sash                                  | White                         |  |                         |
|   | Window  | White                         |  |                         |
| Trim Items  | Fascia  | White                         |  |                         |
|   | Soffit  | White                         |  |                         |
|   | Gutters and D.S.                                      | Brown 20313                   |  |                         |
|   | Awnings and canopies                                  | 23717                         |  |                         |
|   | Stair or balcony railings, balusters and related trim | Chocolate                     |  |                         |
|   | Handrails   | Brown 20313                   |  |                         |



| Building Design Element |   | Required Color Standard | Color Sample   | Notes |
|-------------------------|---|-------------------------|--|-------|
| Trim Items              | Fire Escapes  | Chocolate               |   |       |
|                         | Grilles and louvers   | Brown 20313             |   |       |
|                         | Coping  | Brown 20313             |   |       |
|                         | Roof ventilators  | Blend to match roof     |  |       |
| Related Site Structures | Courtyard enclosure walls, retaining walls, fences, dumpster enclosures | Red Brick or Chocolate  | <br> |       |
|                         | Porch crawl space enclosure   | White                   |   |       |

## NOTES

|               |   |
|---------------|---|
| <b>Note 1</b> | <i>Installation: Enter notes where applicable</i>   |
| <b>Note 2</b> | <i>Installation: Tab to expand note listings</i>  |
| <b>Note 3</b> | Identify type, color and texture of local brick, stone, to include mortar color and joint style |

## **Appendix G**

### **GIS Data**



## Fort Sill GIS (Geographic Information Systems) Deliverable Specifications

This document establishes the requirements for geospatial data deliverables produced as part of a contract. It includes description of the:

- **Deliverables**
- **Coordinate System and Datums:**
- **Data Quality Standard:**
- **SDSFIE-Compliant GIS Deliverable Specifications:**
- **FGDC compliant Metadata**

### Deliverables

The intent of the GIS Deliverable set is to provide Fort Sill with comprehensive geospatial information about the facility footprint and site features that exist outside the building (s). The electronic deliverables must be in the file format and data standard used by Fort Sill and defined below.

File or Personal Geodatabase **ESRI 9.3.1** format or **ESRI 9.3.1** Shapefile format unless otherwise communicated through COR and stated in SOW.

SDSFIE-Compliant GIS Deliverable Specification;

FGDC Compliant Metadata;

Coordinate System and Datum's in this document.

### Coordinate System and Datums

Acceptable coordinate systems are standardized by (USAEC) U.S. Army Environmental Command.

All geospatial deliverables whether obtained via survey or any other collection process, shall be measured in [feet or meters]. The coordinate system for all geospatial data will be:

Coordinate System: GCS\_WGS\_1984

Projection: UTM (Universal Transverse Mercator), Zone 14N.

Horizontal Datum: WGS84 (World Geodetic Survey) 1984

Vertical Datum: NAVD88 (North American Vertical Datum) 1988

Specifications:

Projected Coordinate System: WGS\_1984\_UTM\_Zone\_14N

Projection: Transverse Mercator

False\_Easting: 500000.00000

False\_Northing: 0.00000

Central\_Meridian: -99.00000

Scale\_Factor: 0.999600

Latitude\_of\_Origin: 0.00000

Linear\_Unit: Meter

Geographic Coordinate System: GCS\_WGS\_1984

Datum: D\_WGS\_1984

Prime Meridian: Greenwich

Angular Unit: Degree



## Data Quality Standard

Topology and positional accuracy are the first components of data quality that will be assessed by Fort Sill. These components are grouped together because changing either component has a direct effect on the other. Topology will be checked prior to positional accuracy, and positional accuracy will only be assessed if the data are topologically sound.

If a data layer is submitted a second time for Fort Sill review, both positional accuracy and topology will be reassessed. The data can only be reported as being topologically correct *and* positionally accurate. Reporting the data as meeting one requirement but not the other is not possible.

Positional accuracy is the difference between the location of features in the GIS data layer and their true locations on the ground. Positional accuracy applies in both the horizontal and vertical plane. The minimum acceptable horizontal and vertical accuracy of each data layer where vertical coordinates are collected is +/- 2cm.

Topology is how point, line, and polygon features share geometry. Fort Sill will verify that each data layer adheres to the topology rules defined below. The contractor shall utilize a topology build and clean routine and assure that the following:

### Point features

- Must be inside polygons of "Parent" feature class, if applicable.
- Should be digitized as points, not graticules, cells, symbols or icons.

### Line features

- Must not have erroneous self overlap, self intersect, overshoots, undershoots or dangles.
- Lines should all be continuous, i.e. do not create dashed lines with many small line segments
- Lines shall be surveyed at a minimum of two (2) points along every straight run, at every change of direction, at every tie in point, and at any change in line size.

### Polygon features

- Must not have erroneous self overlap or gaps.
- Must be covered by the installation\_area feature class unless SOW states differently.
- Must contain points of the "Child" feature class, if applicable.
- Digital representation of the common boundaries for all graphic features must be coincident, regardless of feature layers.

The contractor shall use conventional surveying and other methods, such as a total station or GPS for field data collection at an accuracy level in accordance with: "Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering Construction, and Facilities Management."

Published by the FGDC and available at

[http://www.fgdc.gov/standards/standards\\_publications/index.html](http://www.fgdc.gov/standards/standards_publications/index.html).

Fort Sill has determined that the contractor may use industry-accepted standard procedures for preparing drawings showing the location of site features as constructed. The contractor must include in the metadata a brief discussion of the methods used and the resulting horizontal and vertical accuracy of the data.

Fort Sill preference is for the contractor to certify that all features as mapped are accurate within [ +/- 0.5 meters] as determined through procedures in accordance with:

"Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering Construction, and Facilities Management."

Published by the FGDC and available at

[http://www.fgdc.gov/standards/standards\\_publications/index.html](http://www.fgdc.gov/standards/standards_publications/index.html).



## **SDSFIE (Spatial Data Standards for Facilities, Infrastructure and Environment)-Compliant Deliverable Specification**

### *Geodatabase Template*

Upon request Fort Sill will provide the contractor with an SDSFIE 2.606 -compliant GIS geodatabase template to be used for populating the GIS deliverables required under the contract, or the contractor may download a complete SDSFIE compliant database model from:

<http://www.sdsfie.org/SDSFIEHome/tabid/36/Default.aspx>

The contractor shall populate the layers without modifying the template. The contractor shall ensure that layers to be delivered, but not included in the template are compliant with the current SDSFIE 2.606 standard.

There may be circumstances in which SDSFIE compliance cannot be maintained. In such circumstances, proposed deviations with the standard must be communicated by the contractor and reviewed by Fort Sill.

SDSFIE Browser and Browser Lite are available downloads from:

<http://www.sdsfie.org/SDSFIEHome/tabid/36/Default.aspx>

These browsers are invaluable tools that contain definition by structure, feature, alias, keyword, attribute or data source. These browsers contain the answers of where layers are stored, the required attributes, domain values and symbology required by Fort Sill and other DOD agencies.

Also available for download is the ESRI GeoDB Builder Tool. This tool allows the contractor to define what layers are needed and populate these layers with applicable attribute tables according to SDSFIE standard formatting.

## **FGDC Compliant Metadata**

Metadata is data about data. All metadata generated by or for Federal agencies must meet the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM). A metadata file is considered complete when all required fields are populated with valid values. Metadata accuracy is a measure of how well the data creator documented the data creation process.

The contractor shall prepare metadata conforming to Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM) most Current version (<http://www.fgdc.gov/metadata/contstan.html>).

Metadata content will accompany all electronic geospatial data submissions.

This includes both CADD and GIS formats.

A metadata file shall accompany, at minimum, each CADD file and each GIS-format geospatial data layer delivered by the contractor. Metadata should be prepared to FGDC standards and delivered in XML format readable by software applications that use the FGDC XML format standard (such as ESRI ArcCatalog v9.x SML-format metadata files). The digital metadata files shall be provided to Fort Sill along with each product deliverable.

## Metadata Standards for Army Installation Geospatial Data

### Section 1 – Identification

| CSDGM Element Number    | CSDGM Element Name                            | Description  | Valid Values   |
|-------------------------|---|--|--|
| <b>1.1 Citation</b>     |   |  |  |
| 1.1<br>(Citation 8.1)   | Identification<br>(Data Set Originator)       | The name of the office/branch/section and/or program that created the data set. This will contain USA, a single space, office/branch/section and/or program, a single space, followed by the installation/site name.   | <i>Example values:</i><br>“USA Master Planning Office Fort x”  |
| 1.1<br>(Citation 8.2)   | Identification<br>(Data Set Publication Date) | The date of release or current version of the file. This represents the date that a given overlay layer and associated metadata file were “locked” for approval by the base-level command authority.<br><br>Lineage: The data when the source was published or otherwise made available for release.   | <i>Format:</i><br>yyyymmdd   |
| 1.1<br>(Citation 8.4)   | Identification<br>(Data Set Title)            | The name by which the data set is referred. For all Army installations data this will contain the SDSFIE Entity Type name followed by the installation/facility name. To enhance searchability all underscores will be replaced with spaces.<br><br>Lineage: The name by which the source of the layer is known. This could be the name of a local study, a national data set, a standard business process by which the data are generated, etc. | <i>Example values:</i><br>“Installation Area Fort x”<br>“Military Range Area Fort x”<br>“Flood Zone Area Camp x”<br>“Wetland Area Fort x”<br>“Mil Qty Distance Arc Area Fort x”<br>“Noise Zone Area Camp x”<br><br>Free text.<br>Ex. “Short-Range Component”, “National Hydrology Dataset” |
| 1.1<br>(Citation 8.6)   | Geospatial Data Presentation Form             | The mode in which geospatial data depicted in a layer were represented.  | “Vector Digital Data”  |
| 1.1<br>(Citation 8.8.2) | Identification<br>(Data Set Publisher)        | The name of the Army component or program that published the data set.   | <i>Valid Values:</i><br>“OACSIM IGI&S”, “USAR”, “USARNG”<br>“SRP”, “AEC”   |
|                         |   |  |  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number              | CSDGM Element Name                               | Description  | Valid Values   |
|-----------------------------------|--|--|--|
| <b>1.2 Description</b>            |  |  |  |
| 1.2.1                             | Description, Abstract                            | A brief narrative of the data set. For all Army installation data the SDSFIE Entity Type Definition will be used.  | Valid values: SDSFIE Entity Type Definition<br><br>Ex. Land and water currently owned or used by the military installation or facility |
| 1.2.2                             | Description, Purpose                             | A summary of the intentions with which the data set was developed.<br><br><i>Note: Each program should develop a standard purpose to fit within their program.</i>   | <i>As defined by Army Program Leads (ARNG, AEC, OACSIM, IMA..etc)</i>  |
| <b>1.3 Time Period of Content</b> |  |  |  |
| 1.3<br>(Citation 9.1.1)           | Time Period of Content<br>(Single Calendar Date) | The latest date to which the data content represents conditions on the ground (that is, when the “real world” looked the way it is described in the data). If the data content represents features presented from an image or map product and are not verified to current real world conditions this data must be the date of the image or map product source.<br><br>Note: This assumes the image or map product source date represents ground conditions for that date.<br><br>If only the month and year of the date are known enter zeros (“0”) in the place of “dd” (for day) as shown. Ex. 20050400 represents April 2005. | <i>Format:</i><br>yyyymmdd   |
| 1.3.1                             | Time Period of Content, Currentness Reference    | Reference for the Time Period of Content. For all Army installation data this value will be “ground condition”.  | <i>Valid Value:</i><br>“Ground Condition”  |
| <b>1.4 Status</b>                 |  |  |  |
| 1.4.1                             | Status, Progress                                 | The state of the data set.<br><br><b>Note:</b> Data sets required for reporting to the Army GISR are not   | <i>Valid Values:</i><br>“Complete”<br>“In-Work”  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number      | CSDGM Element Name                       | Description   | Valid Values   |
|---------------------------|--|---|--|
|                           |  | complete until approved by the designated Command Authority.  |  |
| 1.4.2                     | Status, Maintenance and Update Frequency | <p>The frequency with which changes and additions are made to the data set after the initial data set is completed.</p> <p><b>Note:</b> Data sets required for reporting to the Army GISR will have the update frequency defined by regulation.</p> | <p><i>Valid Values:</i></p> <p>“Bianually”</p>   |
| <b>1.5 Spatial Domain</b> |  |   |  |
| 1.5.1                     | Spatial Domain, Bounding Coordinates     | The outermost limits of coverage of a data set expressed by latitude and longitude values in the order western-most (CSDGM element 1.5.1.1), eastern-most (1.5.1.2), northern-most (1.5.1.3), and southern-most (1.5.1.4).                          | <p><i>Valid Values:</i></p> <p><i>Latitude:</i> -90.00 to 90.00</p> <p><i>Longitude:</i> -180.00 to 180.00</p>   |
| <b>1.6 Keywords</b>       |  |   |  |
| 1.6.1.1                   | Theme Keyword Thesaurus                  | Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.   | <p><i>Valid Value:</i></p> <p>“Spatial Data Standard for Facilities, Infrastructure, and Environment” (version number).</p>  |
| 1.6.1.2                   | Theme Keyword                            | Common-use words or phrase words used to describe the subject of the data set. Must include the installation name, entity type, entity class and entity set in addition to one or more of the remaining values in the list.                         | <p><i>Required Keyword Values:</i></p> <p>{ installation name }</p> <p>{ service component }</p> <p>{ entity type }</p> <p>{ entity class }</p> <p>{ entity set }</p> <p><i>Plus one or more of the following:</i></p> <p>“boundaries”</p> <p>“farming”</p> <p>“climatologyMeteorologyAtmosphere”</p> <p>“biota”</p> <p>“economy”</p> <p>“planningCadastre”</p> <p>“society”</p> <p>“elevation”</p> <p>“environment”</p> |



## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number  | CSDGM Element Name                   | Description   | Valid Values  |
|---|--------------------------------------|---|---|
|   |                                      |   | "structure"<br>"geoscientificInformation"<br>"health"<br>"imageryBaseMapsEarthCover"<br>"inlandWaters"<br>"location"<br>"intelligenceMilitary"<br>"oceans"<br>"transporation"<br>"utilitiesCommunication" |
|   | Place Keywords                       | Geographical location of a dataset. This should include: country, state or territory, region, city, garrison, installation or site.   |   |
| <b>1.7 Access Constraints</b>   |                                      |   |   |
| 1.7   | Access Constraints                   | Restrictions and legal prerequisites for accessing the data set. These include any access constraints applied to assure the protection of privacy or intellectual property, and any special restrictions on obtaining the data set.                     | Valid Value:<br>Data are to be used by Army personnel and Army support personnel only unless a written request to the IGI&S Government POC has been approved.   |
| <b>1.8 Use Constraints</b>  |                                      |   |   |
| 1.8   | Use Constraints                      | Restrictions and legal prerequisites for using the data set after access is granted. These include constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the data set. | <i>As defined by Army Program Leads (ARNG, AEC, OACSIM, IMA..etc)</i>   |
| <b>1.9 Point of Contact</b>   |                                      |   |   |
| <p><i>The point of contact should be the Subject Matter Expert (SME) who identified the data source, and shall not be the base-level GIS/mapping POC (unless the POC authoring the metadata file is the same person as the subject matter expert responsible for source selection). In the event the SME expert is a contractor, the organizational information should reflect the government office for which the contractor works, not the contractor company information.</i></p> <p><i>The name of the individual/organization responsible for creating the metadata file is recorded in CSDGM element 7.4, Metadata Contact.</i></p> |                                      |   |   |
| 1.9<br>(Citation 10.1.1)  | Point of Contact<br>(Contact Person) | Name of Subject Matter Expert responsible for selecting the source for the given layer  | Free text field<br>Ex: "John Smith"   |

## Metadata Standards for Army Installation Geospatial Data

| <b>CSDGM<br/>Element<br/>Number</b> | <b>CSDGM<br/>Element Name</b>                   | <b>Description</b>   | <b>Valid Values</b>   |
|-------------------------------------|---|--|---|
| 1.9<br>(Citation<br>10.1.2)         | Point of Contact<br>(Contact<br>Organization)   | Organization name (or office symbol for military organizations) of the subject matter expert.  | Free text field<br>Ex: "Fort Drum Dept of Public Works", "Fort Monmouth Directorate of Public Safety"     |
| 1.9<br>(Citation<br>10.3)           | Point of Contact<br>(Contact<br>Position/Title) | Title of the subject matter expert.  | Free text field   |
| 1.9<br>(Citation<br>10.4.1)         | Point of Contact<br>(Address Type)              | The type of address provided. Must be one of the following valid values:   | <i>Valid Values:</i><br>"mailing"<br>"physical"<br>"mailing and physical"<br>"po box"<br>Other (describe) |
| 1.9<br>(Citation<br>10.4.2)         | Point of Contact<br>(Address)                   | Address line for the subject matter expert.  | Free text field<br>Ex: "1230 Main Street"   |
| 1.9<br>(Citation<br>10.4.3)         | Point of Contact<br>(City)                      | The address city for the subject matter expert.  | Free text field<br>Ex: "Honolulu", "San Diego"  |
| 1.9<br>(Citation<br>10.4.4)         | Point of Contact<br>(State or Territory)        | The address state or territory for the subject matter expert. Use accepted two-letter Postal state/territory codes for this field.   | Free text field<br>Ex: "NY", "VA", "PR"   |
| 1.9<br>(Citation<br>10.4.5)         | Point of Contact<br>(Postal/ZIP Code)           | The ZIP code for the subject matter expert. Nine digit ZIP codes, with dashes, preferred, but five digit zip codes will be accepted.   | Free text field<br>Ex: "22030-1260"   |
| 1.9<br>(Citation<br>10.4.6)         | Point of Contact<br>(Country)                   | Subject matter expert address country.   | Free text field<br>Ex: "USA"  |
| 1.9<br>(Citation<br>10.5)           | Point of Contact<br>(Telephone<br>Number)       | Subject matter expert Telephone number, including all applicable area codes and extensions.<br>Commercial numbers are preferred, and should be preceded with "COMM" as shown. However, if only DSN numbers are | Free text field<br><i>Ex:</i><br>COMM 123-456-7890<br>DSN 123-4567  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number             | CSDGM Element Name                  | Description   | Valid Values  |
|----------------------------------|-------------------------------------|---|---|
|                                  |                                     | available, enter that number here and precede the number with "DSN" as shown: |   |
| 1.9<br>(Citation 10.8)           | Point of Contact<br>(EMAIL address) | The email address for the subject matter expert.                              | Free text field<br>Ex: "John.Smith@us.army.mil"                 |
| <b>1.12 Security Information</b> |                                     |   |   |
| 1.12.1                           | Security Classification System      | The name of the classification system.  | <i>Valid Values:</i>  |
| 1.12.2                           | Security Classification             | The name of the handling restrictions on the data set.                        | <i>Valid Values:</i><br>"FOUO"<br>"Unclassified"<br>"Sensitive" |

## Section 2 – Data Quality Information

| CSDGM Element Number               | CSDGM Element Name         | Description   | Valid Values  |
|------------------------------------|----------------------------|---|---|
| <b>2. Data Quality Information</b> |                            |   |   |
| <b>2.1 Attribute Accuracy</b>      |                            |   |   |
| 2.1.1                              | Attribute Accuracy Report  | Assessment of the accuracy of assigned values in the dataset. Detailed explanation of the accuracy of the dataset values, tests utilized to obtain these accuracy values and a date when the test was executed. | Attribute value domains and ranges are verified against a set domain of values according to SDSFIE. Content is populated according to the Standard Operating Procedures for that layer. Specific value content is verified by an authority with site knowledge and access to other sources. |
| 2.2                                | Logical Consistency Report | Logical consistency describes how the geometry was  | Free text field   |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number           | CSDGM Element Name                    | Description   | Valid Values   |
|--------------------------------|---------------------------------------|---|--|
|                                |                                       | captured and explains any topological test that may have been performed. Since most commercial GIS software structures data topologically, simply describing the process of how the data was captured addresses this report.  | Ex: Topology verified using the ArcINFO clean command.   |
| 2.3                            | Completeness Report                   | <p>Information about omissions, selection criteria, generalizations, definitions used, and other rules to derive the dataset.</p> <p>Use this field to record if any features (e.g., wetland polygon, floodplain polygon, APZ or ESQD clear zone, noise contour, or installation boundary element) were excluded from the data set for any reason.</p> <p>Note: This report should include all feature types that are present in the dataset.</p>   | <p><i>If no omissions are present – Valid Value:</i><br/>“Complete data set”</p> <p><i>If omissions are present – Valid Value:</i><br/>Free text, describing any map features/elements that exist on the ground but have been omitted from the dataset due to classification constraints.</p> <p><i>Example Values:</i><br/>“Wetlands from 1999 restoration study not included because {provide justification}”<br/>“New boundary from 2003 land transfer to {jurisdiction} not shown as the boundary re-survey has not yet been performed.”</p> |
| <b>2.4 Positional Accuracy</b> |                                       |   |  |
| 2.4.1.1                        | Horizontal Positional Accuracy Report | <p>A narrative explanation of the accuracy of the horizontal coordinate measurements. Use this field to record the horizontal positional accuracy of digital geospatial data sources and the published map scale of hardcopy/paper map sources, as stated on the selected source.</p> <p>Valid values must be stated in one of the following two fashions:</p> <ul style="list-style-type: none"> <li>• Circular error, as defined by FGDC STD 007.3-1998, NSSDA, (digital sources) or</li> <li>• Meeting National Map Accuracy Standards (NMAAS) at a given printed map scale (hardcopy/paper sources).</li> </ul> | <p><i>Example Values:</i><br/><i>Circular Error Format:</i><br/>“4-meter CE 90 (1-meter imagery)”<br/>“25-meter CE 90 (5-meter imagery)”</p> <p><i>National Map Accuracy Standards:</i><br/>“Meets National Map Accuracy Standards at {map scale}”</p> <p><i>If the layer was created using “heads-up” digitizing techniques and another image or overlay layer was used as reference:</i><br/>“Referenced to {imagery or overlay layer name}”</p> <p><i>If horizontal positional accuracy is unknown:</i></p>                                   |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number   | CSDGM Element Name                                    | Description  | Valid Values   |
|--|---|--|--|
|  |   |  | "Unknown"  |
| 2.4.2.1  | Vertical Positional Accuracy Report                   | Explanation of achieved accuracy, methods for ascertaining the accuracy values and dates of tests utilized to obtain those results.  | Valid Values:<br>Free text field or<br>"NA"  |
| <h3>2.5 Lineage</h3> <p><i>The following section may be repeated numerous times in the event that multiple sources were selected and used to develop any given layer. Most metadata management applications (including ESRI ArcCatalog and the USACE CorpsMet application) can accommodate numerous source citations.</i></p> <p><i>A set of Lineage, Process Description and Process Point of Contact elements are used to record the GIS technical point of contact.</i></p> <p><i>An additional set of Process Description elements are used to record the process and contact information for the data validation (signature) process.</i></p> <p><i>The following Lineage elements are used to record the source data information for the data set described.</i></p> |   |  |  |
| 2.5.1.1<br>(Citation 8.1)  | Lineage, Source Citation<br>(Source Originator)       | The name of the individual or organization that developed the source of the data set.  | Valid Values:<br>{Source originator name}  |
| 2.5.1.1<br>(Citation 8.2)  | Lineage, Source Citation<br>(Source Publication Date) | The date when the source was published or otherwise made available for release.<br><br>If only the month and year are known, but not specific day within the given month, enter zeros ("0") in the place of "dd" as shown.<br><br>Must be one of the following valid values: | Valid Values:<br>"Unknown"<br>"Unpublished material"<br>{date}<br><br>Date Format:<br>yyyymmdd<br><br>Example date values:<br>"20020101" (representing 01 Jan 02)<br>"20031128" (representing 28 Nov 03)<br>"19980100" (representing Jan 98, where the specific day is not provided) |
| 2.5.1.1<br>(Citation 8.4)  | Lineage, Source Citation<br>(Source Title)            | The name by which the source of the layer is known. This could be the name of a local study, a national data set, a standard business process by which the data are generated, etc.  | Valid Values:<br>{source name}<br><br>Example values:<br>"National Wetlands Inventory"   |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number   | CSDGM Element Name  | Description  | Valid Values   |
|--|---|--|--|
|  |   |  | “USACHPPM Noise Study”<br>“FEMA Flood Insurance Study for {jurisdiction}”  |
| 2.5.1.1<br>(Citation 8.6)  | Lineage, Source Citation<br>(Geospatial Data Presentation Format) | The mode in which geospatial data depicted in the layer were represented in the source document(s). Must be one of the following valid values: | <i>Valid Values:</i><br>“Diagram”<br>“Map”<br>“Model”<br>“Profile”<br>“Raster digital data”<br>“Spreadsheet”<br>“Tabular digital data” (e.g., coordinates)<br>“vector digital data”<br>Other (specify) |
| 2.5.1.1<br>(Citation 8.8.2)  | Lineage, Source Citation<br>(Publisher)                           | The name of the individual or organization that published the data set source. Must be one of the following valid values:                      | <i>Valid Values:</i><br>{publisher name/organization}<br>“Unknown”<br>“N/A”  |
| 2.5.1.6  | Lineage, Source Contribution                                      | An indicator of which source for the data set was used.  | <i>Example Values for Layers:</i><br>Values vary by layer type and by which source was chosen.   |
| <b><i>The following Process Description elements describe the actions performed against the above sources in order to create the data. The POC listed below is the GIS technical point of contact.</i></b> |   |  |  |
| 2.5.2.1  | Lineage, Process Description                                      | General description of the process used to convert or create the data.   | Free text field  |
| 2.5.2.3  | Process Date  | Date for the completion of data compilation.   |  |
| 2.5.2.6<br>(Citation 10.1.1)   | Process Point of Contact<br>(Contact Person)                      | Party or parties responsible for the computation of the processing step information.   | Free text field<br>Ex. “John Smith”  |
| 2.5.2.6<br>(Citation 10.1.2)   | Process Point of Contact<br>(Contact Organization)                | Organization name (or office symbol for military organizations) of the POC.  | Free text field<br>Ex: “Fort Drum Dept of Public Works”,<br>“Fort Monmouth Directorate of Public Safety”   |
| 2.5.2.6<br>(Citation 10.3)   | Process Point of Contact<br>(Contact Position/Title)              | Title of the point of contact.   | Free text field  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number  | CSDGM Element Name                               | Description   | Valid Values  |
|---|--|---|---|
| 2.5.2.6<br>(Citation 10.4.1)  | Process Point of Contact<br>(Address Type)       | The type of address provided. Must be one of the following valid values:  | <i>Valid Values:</i><br>“mailing”<br>“physical”<br>“mailing and physical”<br>“po box”<br>Other (describe) |
| 2.5.2.6<br>(Citation 10.4.2)  | Process Point of Contact<br>(Address)            | Address line for the point of contact.  | Free text field<br>Ex: “1230 Main Street”   |
| 2.5.2.6<br>(Citation 10.4.3)  | Process Point of Contact<br>(City)               | The address city for the point of contact.  | Free text field<br>Ex: “Honolulu”, “San Diego”  |
| 2.5.2.6<br>(Citation 10.4.4)  | Process Point of Contact<br>(State or Territory) | The address state or territory for the point of contact. Use accepted two-letter Postal state/territory codes for this field.   | Free text field<br>Ex: “NY”, “VA”, “PR”   |
| 2.5.2.6<br>(Citation 10.4.5)  | Process Point of Contact<br>(Postal/ZIP Code)    | The ZIP code for the point of contact. Nine digit ZIP codes, with dashes, preferred, but five digit zip codes will be accepted.   | Free text field<br>Ex: “22030-1260”   |
| 2.5.2.6<br>(Citation 10.4.6)  | Process Point of Contact<br>(Country)            | Point of contact address country.   | Free text field<br>Ex: “USA”  |
| 2.5.2.6<br>(Citation 10.5)  | Process Point of Contact<br>(Telephone Number)   | Point of contact telephone number, including all applicable area codes and extensions.<br>Commercial numbers are preferred, and should be preceded with “COMM” as shown. However, if only DSN numbers are available, enter that number here and precede the number with “DSN” as shown: | Free text field<br><i>Ex:</i><br>COMM 123-456-7890<br>DSN 123-4567  |
| 2.5.2.6<br>(Citation 10.8)  | Process Point of Contact<br>(EMAIL address)      | The email address for the point of contact.   | Free text field<br>Ex: “John.Smith@us.army.mil”   |
| <b><i>The following lineage section represents the metadata elements that should be populated for the Signature Authority process and point of contact.</i></b> |  |   |   |
| 2.5.2.1   | Lineage, Process Description                     | Description of the signature process.   | <i>Valid Values:</i>  |
| 2.5.2.3   | Process Date                                     | Date the data was validated through signature (signature date).   |   |
| 2.5.2.6   | Signature Authority Point of                     | Name of the individual appointed as the Signature   | Free text field   |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number         | CSDGM Element Name   | Description   | Valid Values   |
|------------------------------|--|---|--|
| (Citation 10.1.1)            | Contact<br>(Contact Person)                                      | Authority.  | Ex. "John Smith"   |
| 2.5.2.6<br>(Citation 10.1.2) | Signature Authority Point of Contact<br>(Contact Organization)   | Organization name (or office symbol for military organizations) of the Signature POC.                                     | Free text field<br>Ex: "Fort Drum Dept of Public Works",<br>"Fort Monmouth Directorate of Public Safety" |
| 2.5.2.6<br>(Citation 10.3)   | Signature Authority Point of Contact<br>(Contact Position/Title) | Title of the Signature Authority.   | Free text field  |
| 2.6                          | Cloud Cover  | Area of data set obstructed by clouds expressed as a percentage of the spatial extent. Applicable to raster imagery only. | <i>Valid Values:</i> 0-100%  |

## Section 3 – Spatial Data Organization Information

Not required

## Section 4 – Spatial Reference Information

| CSDGM Element Number  | CSDGM Element Name   | Description  | Valid Values                                 |
|---|----------------------|--|--|
| <b>4.1 Horizontal Coordinate System Definition</b>  |                      |  |  |
| <i>The Spatial Reference Information should be defined using one of the following Horizontal Coordinate Systems (4.1.1 Geographic or 4.1.2 Planar {UTM}).</i> |                      |  |  |
| 4.1.1   | Geographic           | The quantities of latitude and longitude which define the position of a point on the Earth's surface with respect to a reference spheroid. |  |
| 4.1.1.1   | Latitude Resolution  | The minimum difference between two adjacent latitude values expressed in Geographic Coordinate Units of measure.                           | <i>Valid Value:</i><br><i>Value &gt; 0.0</i> |
| 4.1.1.2   | Longitude Resolution | The minimum difference between two adjacent longitude values expressed in Geographic Coordinate Units of measure.                          | <i>Valid Value:</i><br><i>Value &gt; 0.0</i> |



## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number  | CSDGM Element Name                                     | Description  | Valid Values   |
|---|--|--|--|
| 4.1.1.3   | Geographic Coordinate Units                            | Measurement units for horizontal coordinates. Must be the following value:   | <i>Valid Value:</i><br>“Decimal Degrees”   |
| 4.1.4.1   | Horizontal Datum Name                                  | Name of the reference system used for defining horizontal coordinates. Must be the following value:  | <i>Valid Value:</i><br>“World Geodetic System of 1984 (WGS 84)”  |
| <b><i>The following Spatial Reference information should be used to define a Universal Transverse Mercator (UTM) Coordinate System.</i></b> |  |  |  |
| 4.1.2   | Planar   | The quantities of distances, or distances and angles, which define the position of a point on a reference plane to which the surface of the Earth has been projected.  |  |
| 4.1.2.2   | Grid Coordinate System,<br>Grid Coordinate System Name | A plane-rectangular coordinate system usually based on, and mathematically adjusted to, a map projection so that geographic positions can be readily transformed to and from plane coordinates.<br><br>The name of the grid coordinate system should be “Universal Transverse Mercator” (UTM). This is a grid system based on the transverse mercator projection, applied between latitudes 84 degrees north and 80 degrees south on the Earth’s surface and consisting of zones numbered from 1-60. | <i>Valid Value:</i><br>“Universal Transverse Mercator”   |
| 4.1.2.2.1   | UTM Zone Number  | The identifier for the UTM Zone  | <i>Valid Value:</i><br>1 <= UTM Zone Number <= 60 for the northern hemisphere;<br>-60 <= UTM Zone Number <= -1 for the southern hemisphere |
| 4.1.2.1.23.17   | Scale Factor at Central Meridian                       | A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance along the central meridian.  | <i>Valid Value:</i><br><i>Value &gt; 0.0</i>   |
| 4.1.2.1.23.2  | Longitude of Central Meridian                          | The line of longitude at the center of a map projection generally used as the basis for constructing the projection.   | <i>Valid Value:</i><br><i>-180.0 &lt;= Longitude of Central Meridian &lt; 180.0</i>  |
| 4.1.2.1.23.3  | Latitude of Projection Origin                          | The latitude chosen as the origin of rectangular   | <i>Valid Value:</i>  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number | CSDGM Element Name    | Description   | Valid Values   |
|----------------------|-----------------------|---|--|
|                      |                       | coordinates for a map projection.   | <i>-90.0 &lt;= Latitude of Projection Origin &lt;= 90.0</i>      |
| 4.1.2.1.23.4         | False Easting         | The value added to all “x” values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in Planar Coordinate Units. | <i>Valid Value:<br/>Free Text</i>                                |
| 4.1.2.1.23.5         | False Northing        | The value added to all “y” values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in Planar Coordinate Units. | <i>Valid Value:<br/>Free Text</i>                                |
| 4.1.2.4.2.1          | Abscissa Resolution   | The (nominal) minimum distance between the “x” or column values of two adjacent points, expressed in Planar Distance Units of measure.<br><br><i>NOTE: This field is auto-populated in ArcCatalog.</i>                          | <i>Valid Value:<br/>Value &gt; 0.0</i>                           |
| 4.1.2.4.4            | Planar Distance Units | Units of measure used for distances.  | <i>Valid Values:<br/>“meters”</i>                                |
| 4.1.4.1              | Horizontal Datum Name | Name of the reference system used for defining horizontal coordinates. Must be the following value:   | <i>Valid Value:<br/>“World Geodetic System of 1984 (WGS 84)”</i> |

## Section 5 – Entity and Attribute Information

| CSDGM Element Number     | CSDGM Element Name | Description   | Valid Values   |
|--------------------------|--------------------|---|--|
| <b>5.1.1 Entity Type</b> |                    |   |  |
| 5.1.1.1                  | Entity Type Label  | The name by which the data set is referred. For all Army installation data the SDSFIE Entity Type name will be used. To enhance searchability all underscores will be replaced with spaces. | <i>Valid Values:<br/>SDSFIE Entity Type (ex: firing line, military range area, noise contour line)</i> |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number            | CSDGM Element Name            | Description  | Valid Values  |
|---------------------------------|-------------------------------|--|---|
| 5.1.1.2                         | Entity Type Definition        | The definition of the entity type.   | <i>Valid Values:</i><br>SDSFIE Entity Type Definition<br>Ex: The designated hazard area that follows the projected trajectory of a munition.  |
| 5.1.1.3                         | Entity Type Definition Source | The source of the entity type definition.  | <i>Valid Value:</i><br>“Spatial Data Standards for Facilities, Infrastructure, and Environment” (enter version number)  |
| <b>5.1.2 Attribute</b>          |                               |  |   |
| 5.1.2.1                         | Attribute Label               | The name of the attribute  | <i>Valid Value:</i><br>SDSFIE attribute name, common name<br>EX: “Attribute Name: hgt_dim, Common Name: Height dimension”   |
| 5.1.2.2                         | Attribute Definition          | The definition of the attribute  | <i>Valid Value:</i><br>SDSFIE attribute definition<br>Ex: “The height of the target.”   |
| 5.1.2.3                         | Attribute Definition Source   | The attribute definition source  | <i>Valid Value:</i><br>SDSFIE (enter version number)  |
| <b>5.2 Overview Description</b> |                               |  |   |
| 5.2.1                           | Entity and Attribute Overview | Statement summarizing the attribute table for the layer.<br><br>Note: If the dataset is in SDSFIE Advance Compliancy, any additional fields in the table must be detailed. | <i>Example Value:</i><br>“Attributes organized by the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), NCITS 353, Version 2.4. Attribute table structure meets basic compliance guidelines as defined by the CADD-GIS Technology Center.<br><br>“Several custom fields have been added to store additional information because this |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number | CSDGM Element Name | Description | Valid Values   |
|----------------------|--------------------|-------------|--|
|                      |                    |             | information does not fit within the current SDSFIE". |

## Section 6 – Distribution Information

| CSDGM Element Number              | CSDGM Element Name   | Description   | Valid Values  |
|-----------------------------------|----------------------|---|---|
| <b>6.2 Resource Description</b>   |                      |   |   |
| 6.2                               | Resource Description | The identifier by which the distributor knows the data set. Must be one of the following values:                | <i>Valid Values:</i><br><i>"Live Data and Maps"</i><br><i>"Downloadable Data"</i><br><i>"Map Files"</i><br><i>"Static Map Images"</i><br><i>"Other Documents"</i><br><i>"Applications"</i><br><i>"Geographic Services"</i><br><i>"Clearinghouses"</i><br><i>"Geographic Activities"</i> |
| <b>6.4 Standard Order Process</b> |                      |   |   |
| 6.4.2.1.1                         | Format Name          | The name of the data file format. This field can be free text or a value may be selected from the domain table. | Free text field or select a value from the drop down list.  |
| 6.4.2.1.7                         | Transfer Size        | The size, or estimated size, of the transferred data set in megabytes.  | <i>Valid Value:</i><br>Transfer size >X   |

## Section 7 – Metadata Reference Information

| CSDGM Element Number | CSDGM Element Name | Description | Valid Values |
|----------------------|--------------------|-------------|--------------|
|----------------------|--------------------|-------------|--------------|

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number  | CSDGM Element Name                           | Description  | Valid Values  |
|---|--|--|---|
| <b>7.1 Metadata Date</b>  |  |  |   |
| 7.1   | Metadata Date                                | Date the metadata file was created or last updated.  | <i>Format:</i><br>yyyymmdd  |
| 7.2   | Metadata Review Date                         | Date of the latest review of the metadata entry.   |   |
| <b>7.4 Metadata Contact</b>   |  |  |   |
| <i>The Metadata Point of Contact (POC) will be the individual responsible for authoring the metadata file. The mission knowledge expert responsible for source selection will be recorded in CSDGM element 1.9, Point of Contact.</i> |  |  |   |
| 7.4<br>(Citation 10.1.1)  | Point of Contact<br>(Contact Person)         | Name of individual responsible for preparing the metadata file.  | Free text field<br>Ex: "John Smith"   |
| 7.4<br>(Citation 10.1.2)  | Point of Contact<br>(Contact Organization)   | Organization name (or office symbol for military organizations) of the POC.  | Free text field<br>Ex: "Fort Drum Dept of Public Works",<br>"Fort Monmouth Directorate of Public Safety"  |
| 7.4<br>(Citation 10.3)  | Point of Contact<br>(Contact Position/Title) | Title of the metadata author.  | Free text field   |
| 7.4<br>(Citation 10.4.1)  | Point of Contact<br>(Address Type)           | The type of address provided. Must be one of the following valid values:   | <i>Valid Values:</i><br>"mailing"<br>"physical"<br>"mailing and physical"<br>"po box"<br>Other (describe) |
| 7.4<br>(Citation 10.4.2)  | Point of Contact<br>(Address)                | Address line for the metadata author.  | Free text field<br>Ex: "1230 Main Street"   |
| 7.4<br>(Citation 10.4.3)  | Point of Contact<br>(City)                   | The address city for the metadata author.  | Free text field<br>Ex: "Honolulu", "San Diego"  |
| 7.4<br>(Citation 10.4.4)  | Point of Contact<br>(State or Territory)     | The address state or territory for the metadata author. Use accepted two-letter Postal state/territory codes for this field. | Free text field<br>Ex: "NY", "VA", "PR"   |
| 7.4   | Point of Contact                             | The ZIP code for the metadata author. Nine digit ZIP   | Free text field   |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number                      | CSDGM Element Name                      | Description  | Valid Values   |
|---|---|--|--|
| (Citation 10.4.5)                         | (Postal/ZIP Code)                       | codes, with dashes, preferred, but five digit zip codes will be accepted.  | Ex: "22030-1260"   |
| 7.4<br>(Citation 10.4.6)                  | Point of Contact<br>(Country)           | Metadata author address country.   | Free text field<br>Ex: "USA"   |
| 7.4<br>(Citation 10.5)                    | Point of Contact<br>(Telephone Number)  | Metadata author telephone number, including all applicable area codes and extensions.<br>Commercial numbers are preferred, and should be preceded with "COMM" as shown. However, if only DSN numbers are available, enter that number here and precede the number with "DSN" as shown: | Free text field<br>Ex:<br>COMM 123-456-7890<br>DSN 123-4567  |
| 7.4<br>(Citation 10.8)                    | Point of Contact<br>(EMAIL address)     | The email address for the metadata author.   | Free text field<br>Ex: "John.Smith@us.army.mil"  |
| <b>7.5 Metadata Standard Name</b>         |   |  |  |
| 7.5                                       | Metadata Standard Name                  | The name of the metadata standard used to document the data set. Must be the following value:  | <i>Valid Value:</i><br>"US Army Installation Geospatial Data Standard tailoring of the FGDC Content Standards for Digital Geospatial Metadata" |
| <b>7.6 Metadata Standard Version</b>      |   |  |  |
| 7.6                                       | Metadata Standard Version               | Identification of the version of the metadata standard used to document the data set. Must be the following value:   | <i>Valid Values:</i><br>"Version 2 - 1998 (FGDC-STD-001 June 1998)"<br><br>"Version 1 – 2005 (OACSIM IGI&S November 2005)"                     |
| <b>7.10 Metadata Security Information</b> |   |  |  |
| 7.10.1                                    | Metadata Security Classification System | The name of the classification system for the metadata.  | <i>Valid Value:</i>  |

## Metadata Standards for Army Installation Geospatial Data

| CSDGM Element Number | CSDGM Element Name               | Description  | Valid Values  |
|----------------------|----------------------------------|--|---|
| 7.10.2               | Metadata Security Classification | The name of the handling restrictions on the metadata. | <i>Valid Values:</i><br>“FOUO”<br>“Unclassified”<br>“Sensitive” |

## Section 8 – Citation Information

Please see Section 1.1 (Citation)

## Section 9 – Time Period Information

Not required

## Section 10 – Contact Information

Please see Section 7.4 (Metadata Contact)

## **Appendix H**

### **Exterior Signage**





## 11.4 SIGNS

11.4.1 Signs are used to visually communicate information. They are highly visible features that should be attractive and compatible with their surroundings. Careful consideration must be given to what a sign says, how it is said, its visual appearance and organization, its location, structural support system, and relation to other signs within the installation. Standardized signage systems facilitate movement, provide a sense of orientation, and reinforce standards of excellence. Signage creates a unifying element throughout the installation that visually ties the installation themes together and builds a reference and continuity that translates into confidence and reassurance when traveling throughout the installation. The standards to apply for signage color,

type, and sizing is found in [Technical Manual \(TM\) 5-807-10, Signage](#).

**11.4.2 Sign System Characteristics.** There are several basic design characteristics that, by serving to convey necessary information clearly and attractively, are an integral part of any successful signage system.

**11.4.2.1 Simplicity.** An effective strategy provides only needed information, avoids redundancy and eliminates oversigning with resultant clutter and visual confusion. Sign messages must be clear, simple, and easy for motorist to process quickly.

**11.4.2.2 Continuity.** It is essential that the system be applied uniformly and consistently throughout the entire installation. The importance of consistent implementation extends from the larger issues of sign type and size down to accurate color continuity and matching typestyles.

**11.4.2.3 Visibility.** Sign location is a very important ingredient within the system. Signs must be located at significant decision points and oriented to provide clear sight lines for the intended user. Close coordination of locations with respect to landscaping, utilities, adjacent signage, and various other street design elements is important to ensure long-term maximum visibility.

**11.4.2.4 Legibility.** Sign typestyle, line spacing, color, and size all combine to create the crucial design characteristics of legibility. This aspect of sign design should take into consideration users such as motorist, pedestrians or bicyclists, and the relative travel speed at which each type of user will be traveling when viewing the signs.

#### 11.4.3 Vocabulary-Communications.

**11.4.3.1** A common language has been created for establishing a signing system. The different components that create the sign package have been named and referred to within the total signing system.

**11.4.3.2** The creation of a "signing language" helps generate a unified bond within sign types that make up a signing family.

- Reference

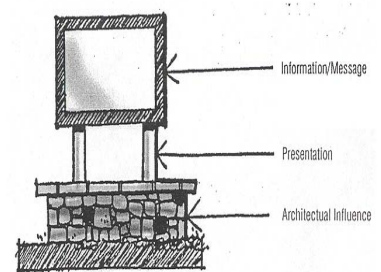


Fig. 11.18 - Signing Language Helps Establish A Signing System

- Information/Message
- Presentation
- Architectural Influence
- Graphic Architecture

#### 11.4.4 Visual Hierarchy.

11.4.4.1 The entire signing system must communicate through a range of sign and typestyle sizes the relative importance of the individual activity that the sign identifies. The system should follow a logical progression from a point of origin to the desired destination.

11.4.4.2 A stated ranking method supports the visual standard of hierarchy within the signing system. Signs can be organized within assigned classes with emphasis on the function and image of the installation.

11.4.4.3 Within each class, the level of architectural influence evokes the importance of the sign to the installation. This is also critical to the idea of progression. The importance of a sign must be presented in its size and level of detail.

11.4.4.4 As individuals move closer to their destination on the installation, the scale of the sign becomes progressively smaller and the level of the message more detailed.

#### 11.4.5 Types of Signs.

##### 11.4.5.1 Information / Identification Signs.

These are signs that identify entrances to the installation, areas within the installation, major tenants, buildings and organizational or functional components (Fig. 11.20). They identify a location, and greet the visitor to that location. They should be compatible in scale and character with the architecture and also blend with the natural surroundings (Fig. 11.20). These signs are designed to include the following:

11.4.5.1.1 Typeface: Lettering is self-adhesive backing material.

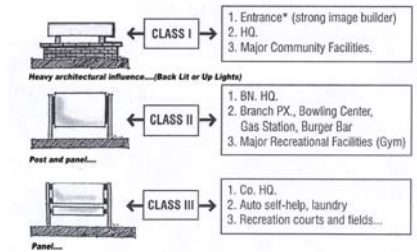


Fig. 11.19 - Signs Can Be Organized Into Classes Within The Visual Hierarchy

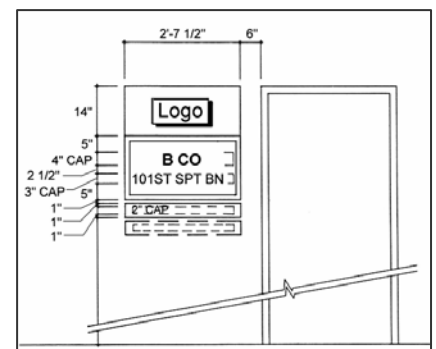


Fig. 11.20 - Building Mounted Information Sign

- Building Title: Helvetica Medium, Upper and lower case
- Building Numbers: Helvetica regular
- Building Addresses: Helvetica Medium, Upper and lower case

#### 11.4.5.1.2 Color:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown
- All paint semi gloss



Fig. 11.20 – Use of Street Addresses

#### 11.4.5.1.3 Materials

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial
- Building numbers: Concealed mechanical fasteners at each corner of panel into building wall (Fig. 11.21).

#### 11.4.5.1.4 Building Identification.

11.4.5.1.4.1 Street Addresses. The addressing procedures prescribed in [DoD 4525.8-M](#), [DoD Official Mail Manual](#) are mandatory for use by all DoD components. DoD 4525.8-M, Chapter 3 prescribes the following:

- All DoD address shall be assigned so they are compatible with the United States Postal Services automated delivery point sequencing. (C3.3)
- The DoD installation is responsible for assigning city-style, street address on the installation. (C3.3.2.2)
- Street addresses shall be assigned and used even though a DoD activity may deliver the mail to the addressee. (C3.3.2.2.1)

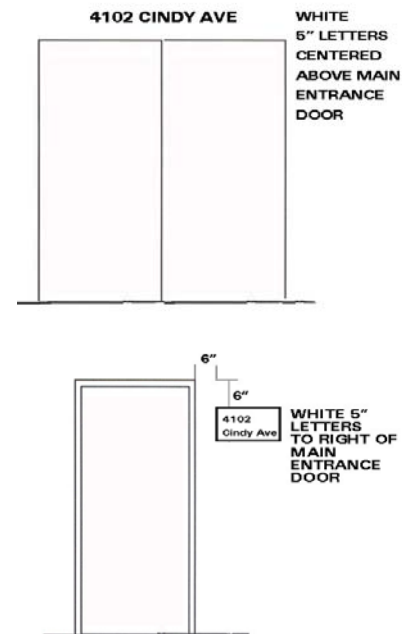


Fig. 11.21 - Street Address Location at Entrance Doors

- Only geographically locatable civilian-style street address (such as 4102 Cindy Avenue, Fig. 11.21) shall be used. (C3.3.2.2.4)
- Installations shall not use one street address for the entire installation and then use secondary unit designators such as "Building 123" to designate the delivery addresses on the installation. (C3.3.2.2.5)
- Addresses such as "Building 123 Roberts Street" are not a valid address format and shall not be used. (C3.3.2.2.6)

#### 11.4.5.1.4.2 Address Placement.

- Place addresses by the front entrance of the building so they can be seen. (C3.3.2.3.1)
- Place both the street name and address number on the building if both the building number and street address are visible from the street.
- Building identification signs will use street addresses (Fig. 11.21).
- Buildings without identification signs shall have the address number and street name centered above the main entrance or located to the right side (Fig. 11.21).

11.4.5.1.4.2 Building Numbers. Where necessary building numbers will be located at a building corner, if visible from the main street and on building side facing parking lots. The size of the sign should be appropriate for the scale of the building and mounting height. See [Technical Manual \(TM\) 5-807-10, Signage](#), para 3-5h, for various sign grid specifications.

#### 11.4.5.1.5 Housing Areas.

11.4.5.1.5.1 The sign should be complimentary to the architectural setting of the housing area and approved by the installation Real Property Planning Board.

11.4.5.1.5.2 Housing numbers should be placed on the curb in front of the respective house and on the house where lighting will effectively light the numbering.

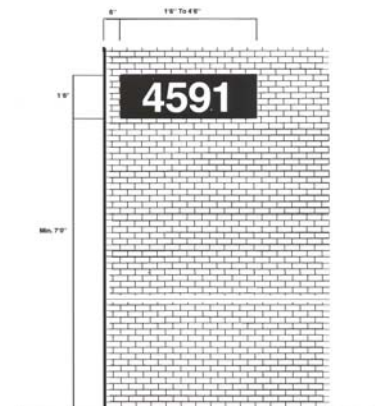


Fig. 11.22 - Dimensions for Building Number Corner Location, Where Necessary

#### 11.4.5.1.6 Installation Identification Signs.

11.4.5.1.6.1 Installation identification signs name the installation and display the official US Army plaque (Fig. 11.23). The designation "United States Army" must appear at the top of the sign in accordance with [AR 420-70](#), para 2-7h. Every installation entrance shall have an installation identification sign displaying only the US Army plaque, with the words "United States Army, Fort (Name of Fort), and gate name as indicated in "Figure 11.23 - Installation Entrance Signs". The placement of Senior Mission Commander logo, unit crest, and other installation identification signs, monuments or displays shall be located inside the installation beyond the cleared area of the Access Control Point of entry. When used service- wide, these signs convey a uniform image of strength and stability to the public. Emblems, branch colors, unit mottos, names and titles of individuals are not to be displayed.

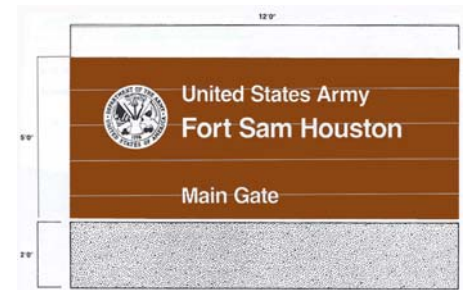


Fig. 11.23 - Installation Entrance Signs

11.4.5.1.6.2 Installation identification signs consist of three types:

- Sign type A1, main entrance sign, identifies the principal visitor entrance.
- Sign type A2, secondary entrance sign, identifies entry points with relatively high volumes of visitor traffic.
- Sign type A3, limited access entry gate signs, identifies entry points with limited public access.

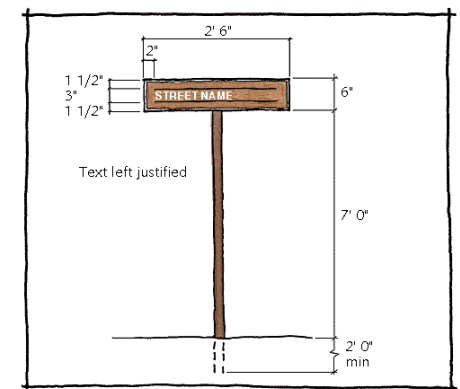


Fig. 11.24 - Typical Street Signs

11.4.5.1.6.3 See [Technical Manual \(TM\) 5-807-10, Signage](#), paragraph 3-3, for sign specifications and paragraph 3-11 for sign placement guidelines.

#### 11.4.5.1.6 Street Signs.

Street name identification signs should be designed with the same lettering, color and materials as other information signs.

#### 11.4.5.1.7 Wheeled Electrical Signs.

Wheeled electrical signs will have an attractive presentation. Temporary landscape elements should be used whenever possible. The siting of this type of sign will be approved by

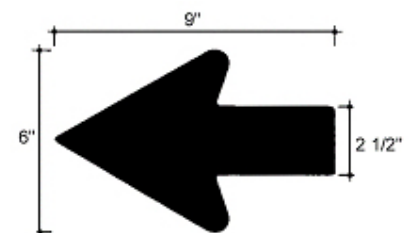


Fig. 11.25 - Typical Arrow For Use On All Destination Signs

the RPPB. No sign of this type will be left in place for longer than six (6) months. After which time, the sign will be removed or turned into a permanent sign.

#### 11.4.5.2 Directional Signs.

These signs guide the motorist or pedestrian in, around, and out of the installation (Fig. 11.26). The legibility and placement of these signs, as well as the ordering of information, is critical to their effectiveness. These signs should be placed in central locations and at major decision points along circulation routes (Fig. 11.26). These signs are designed to include the following:

##### 11.4.5.2.1 Typeface: Lettering is self-adhesive backing material.

- Helvetica Medium upper and lower case

##### 11.4.5.2.2 Arrow:

- Place at end indicating direction.
- Stroke width: Helvetica Medium cap

##### 11.4.5.2.3 Color:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown
- All paint semi gloss

##### 11.4.5.2.4 Materials

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial

#### 11.4.5.3 Regulatory Signs.

These signs provide the rules for travel and parking on the installation. They include speed signs, turning and lane use signs, warning signs, parking control signs, etc. (Fig. 11.27). Related to these signs are pavement markings and traffic signals. These signs are designed to include the following:

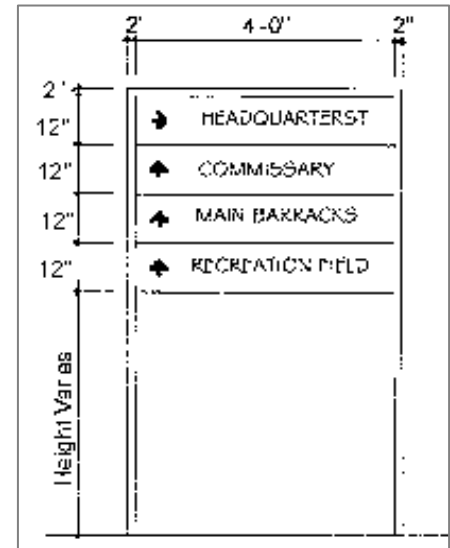


Fig. 11.26 – Direction Sign

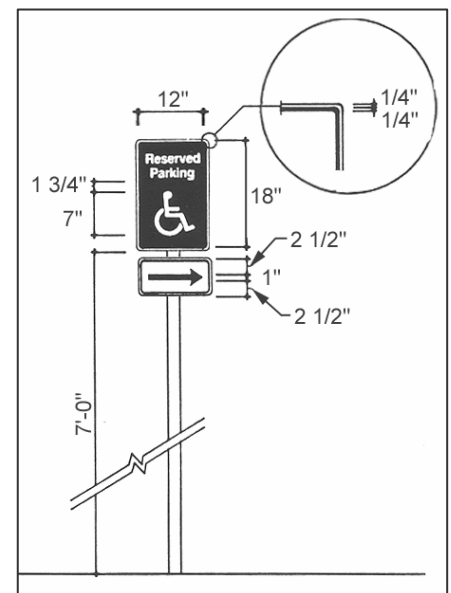


Fig. 11.27 – Regulatory Sign



11.4.5.3.1 Typeface: Lettering is self-adhesive backing material.

- Helvetica Medium upper and lower case

11.4.5.3.2 Color:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown
- All paint semi gloss

11.4.5.3.3 Materials

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial

11.4.5.3.4 Traffic Control Signs.

11.4.5.3.4.1 CONUS Installations. National highway standards will be used for signs to regulate vehicular traffic on CONUS installation ([AR 420-72, Transportation Infrastructure And Dams](#), Para 2-15f). These standards are described in the [Manual of Uniform Traffic Control Devices \(MUTCD\)](#). Also see [MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings](#). This pamphlet clarifies existing standards and provides definite guidelines for installation officials to conform to the MUTCD. These standards shall be used installation wide to include installation Access Control Points.

11.4.5.2.4.2 OCONUS Installations. OCONUS installation streets and roads are to be considered extensions of the road system of the host nation and shall use traffic control device standards and criteria of the host nation ([AR 420-72, Transportation Infrastructure And Dams](#), Para 2-15e).

11.4.5.3.5 Prohibitory (Warning) Signs. This category of signage is intended to maintain security and safety on the installation perimeter and at other specific secure areas. These signs notify visitors of restrictions, as well as other security procedures. The guidelines for design, fabrication, and placement of warning signs are found in [Technical Manual \(TM\) 5-807-10, Signage](#), para 3-9.

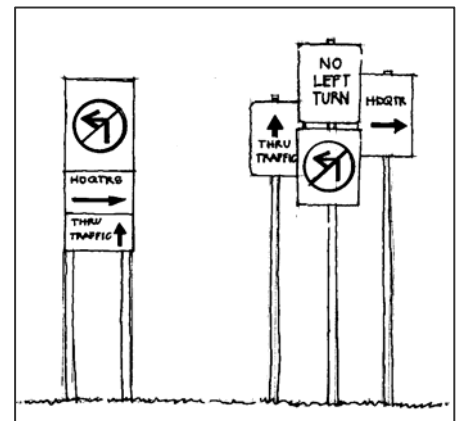


Fig. 11.28 – Sign should be Simple, Legible and Combined



#### 11.4.6 Electronic Exterior Signs

All exterior flashing signs, traveling lights, or signs animated by lights of changing degrees of intensity or color are prohibited.

#### 11.4.7 Sign Placement

Placement of signs differs according to the type of sign and the specific site constraints. The following guidelines apply to placement of the majority of signs.

- Do not place more than one sign at any location. Traffic rules are the exception to this rule (Fig. 11.28).
- Place signs in areas free of visual clutter and landscape materials.
- Place signs in locations that allow enough time for the user to read and react to the message.
- Signs should not be placed to block sight lines at intersections.
- Place signs approximately 1.2 meters (4 feet) above ground level to be within 10 degrees the driver's line of vision (Fig 11.29). Provide proper placement to avoid a hazard to children.

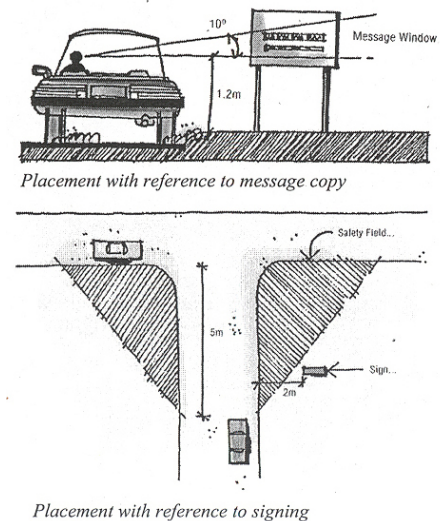


Fig. 11.29 - Placement Is Critical To Ensure Easy Readability

#### 11.4.8 Sign System Typography.

**11.4.8.1 Military Emblems.** The Army has a rich tradition of military heraldry. Military emblems are an important part of the soldiers' identity and the emblems have been carefully crafted over the years to express unit pride and unique history and function of the unit. The care and use of organizational emblems in a signage system can add visual interest as well as build pride and a sense of history. However, the overuse of miscellaneous emblems can lead to clutter and a dilution of their importance. Colors for military emblems must be in accordance with the Institute of Heraldry.

**11.4.8.2 Department of the Army Plaque.** The plaque should be displayed on installation identification signage to emphasize the heritage and professionalism of the United States Army. The design of the plaque must be in accordance with [Army Regulation \(AR\) 840-1, Department of](#)

[the Army Seal, and Department of the Army Emblem and Branch of Service Plaques](#), and must be reproduced in full color.

11.4.8.3 Insignias. The use of branch insignia, shoulder sleeve insignia, coat of arms and/or distinctive insignia on headquarters signs is permitted. All military emblems must appear in full color. Motivational symbols or motifs will not be used.

#### 11.4.9 Reduce Visual Clutter.

11.4.9.1 Over-signing detracts from a uniform sign system and if left uncontrolled will eventually destroy the integrity of the system.

11.4.9.2 Clutter creates confusion and ineffectiveness. Often motorists and pedestrians are confused by the bombardment of messages that have no relationship to each other, or the communication is on such a minimal level that the sign serves no purpose.

#### 11.4.10 Location Maps.

11.4.10.1 The location map is an integral element of an installation entrance. The location map display provides information and sense of place to the viewer. The design and construction should be of compatible architectural materials found throughout the installation.

11.4.10.2 The location map should contain the following characteristics within the design.

- Plexiglas covered map for protection
- Architectural compatible materials used for the base
- Paved walk-up area
- Litter receptacle
- Provide parking adjacent
- Provide current takeaway maps

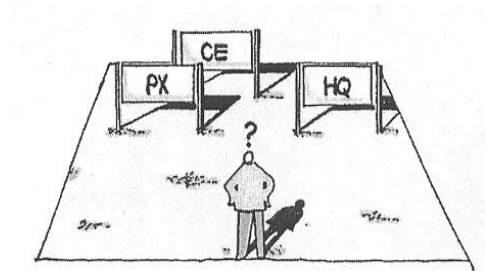


Fig. 11.30 - Visual Clutter Causes Confusion

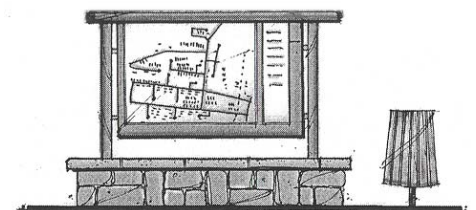


Fig. 11.31 - Location Maps Provide a Sense of Place

# **Appendix I**

## **Acceptable Plant List**



## 10.1 INTRODUCTION

10.1.1 The Landscape Design Standards includes the selection, placement and maintenance of plant material on the installation. Landscape plantings provide a simple and cost effective enhancement to the general appearance of the installation.

10.1.3 The visual image conveyed by Fort Sill is defined not just by architectural character and site organization, but also by an attractive, organized landscape design. The presence of plant material on the installation greatly enhances visual character and environmental quality of the installation.

10.1.2 Plantings add an element of human scale to open spaces and can be used functionally to screen undesirable views, buffer winds, reinforce the hierarchy of the circulation system or provide a visual transition between dissimilar land uses.



Fig. 10.1 - Use native Plants to Improve Visual Quality

## 10.2 LANDSCAPE OBJECTIVES

10.2.1 The overall objective of the use of plant material on Fort Sill is to improve the physical and psychological well being of the people who live and work on the installation. This is achieved through the following objectives:



Fig. 10.2 - Provide Comfort to Pedestrian Environment

- Preserve and enhance urban trees, forest lands, prairies and detailed planting features such as shrubs and groundcovers.
- Improve the overall visual quality of Fort Sill through the use of native plant material to (Fig. 10.1):
- Blend the built environment with the natural environment.
- Provide scale and comfort to pedestrian environments (Fig. 10.2).
- Reinforce the hierarchy of the circulation system (Fig. 10.3).
- Screen unsightly views or elements.
- Buffer incompatible land uses.
- Minimize maintenance through the use of native plant materials that require less maintenance to survive.
- Enhance Antiterrorism capabilities.



Fig. 10.3 - Landscaping Reinforces Circulation Hierarchy

### 10.3 PRINCIPLES OF LANDSCAPE DEVELOPMENT

10.3.1 Landscape design is based on the following principles (Fig. 10.4).

10.3.1.1 **Unity.** The selection and placement of plant material can be used to blend, screen, and soften incompatible architectural or other unattractive visual impacts. Plant material as a unifying element can be placed in front of a building or view to frame and enhance the visual impact.

10.3.1.2 **Balance.** Plant material can be selected and placed to provide visual equilibrium or balance through the use of either a symmetrical or asymmetrical planting scheme. Symmetrical plantings are generally more formal while asymmetrical plantings are informal.

10.3.1.3 **Contrast.** Plant material can be selected and placed to provide differences in size and shape that add interest to the environment. Plants can be located to provide a backdrop for other plants such as a hedge behind a bed of annuals or perennials.

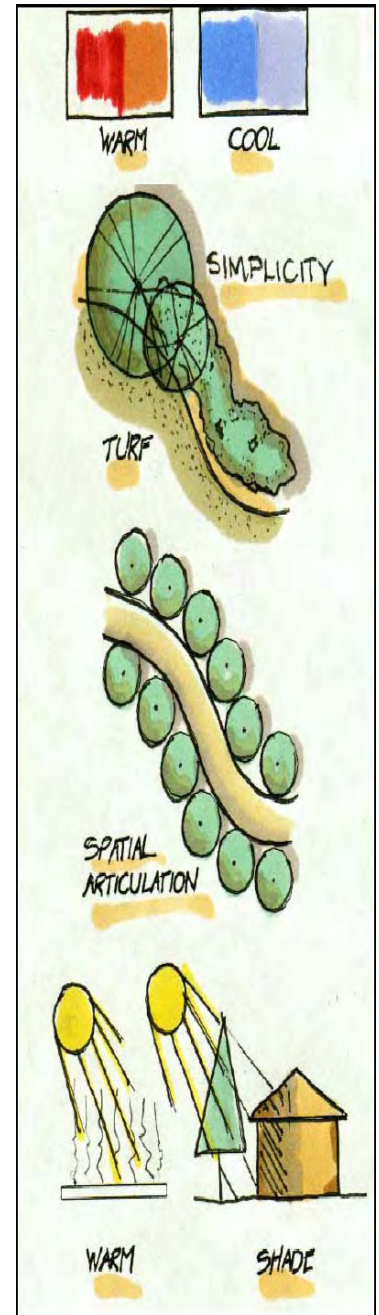


Fig. 10.4 - Principles of Design Illustrated



**10.3.1.4 Rhythm.** Repetition of a single plant or a mass of plants provides visual interest and formality to the landscape. Rhythm produces emphasis and unity and is especially effective in articulating main circulation routes.

**10.3.1.5 Color and Texture.** Plants can be selected and placed to provide visual interest according to their color and texture. Colors are classified as either warm (red, orange, yellow) or cool (violet, blue, green). Texture is classified as either coarse or fine.

**10.3.1.6 Simplicity.** Landscape plans should be broad and simple in form to limit excessive maintenance. Plant material should be grouped in beds with simple edges that are easy to mow. Small turf areas should be avoided because of the difficulty of mowing. The use of annuals should be minimal because of the high maintenance involved.

**10.3.1.7 Ultimate Effect.** The landscape plan should be prepared with consideration for the mature size of all plants. The spacing of all material should utilize nursery industrial standards for mature material to account for spread as well as height. The ultimate height of the material should also be considered in relation to windows and other visual concerns.

**10.3.1.8 Spatial Articulation.** Plants can be selected and placed to create enclosed spaces or to separate spaces from one another. They can also be used to direct people by visually defining and reinforcing patterns of movement. The degree of enclosure, separation, or movement is dependent upon the density, form, and type of plants used.

## 10.4 SUSTAINABLE LANDSCAPE DEVELOPMENT

**10.4.1** The use of plant material promotes the sustainability of the development. Trees, shrubs, groundcover, and vines provide aesthetic appeal as well as preservation of fauna and flora, energy conservation, climate modification, erosion control, air purification, and noise abatement (Fig. 10.5).

## 10.5 LANDSCAPE DESIGN GUIDELINES

**10.5.1** Proposed plantings must be reviewed to ensure that site conditions (soil, topography, adjacent uses, and architecture) and climatic criteria (sun, shade, and moisture requirements) are considered in the desired plant design and selection (i.e., form,

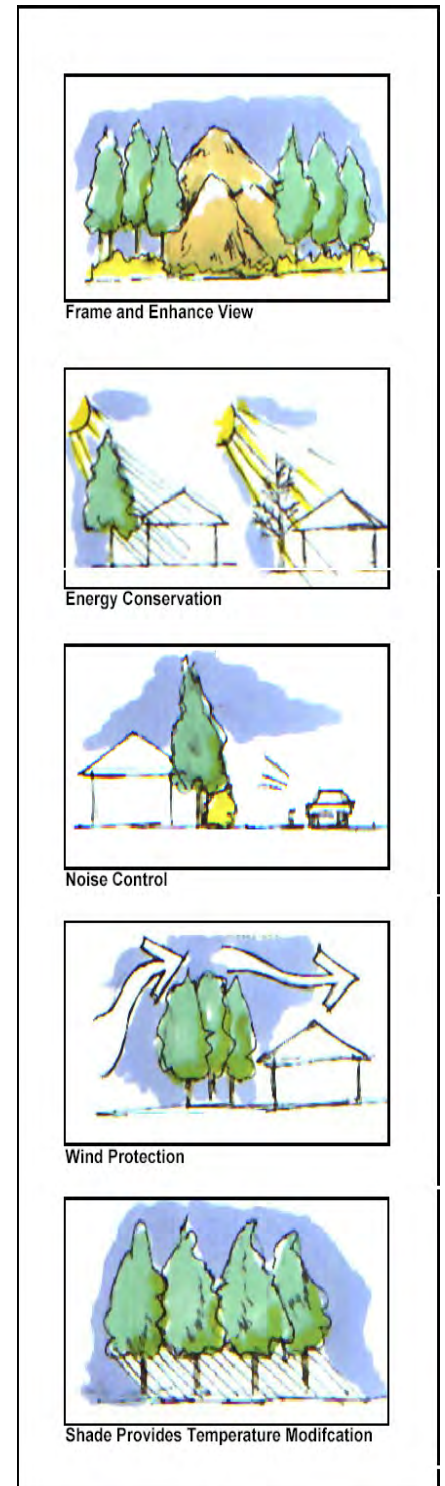


Fig. 10.5 - Plant Material Promotes Sustainability

texture, color, size). The uses and users of the site must also be considered. Landscape planting plans should be approved by qualified personnel to provide quality assurance and promote design consistency within each visual zone.

10.5.2 The following paragraphs present landscaping guidelines for the various locations of plant material use.

**10.5.2.1 Foundation Planting.** Foundation planting provides a green background for additional plantings, adds scale and character to the building, helps to integrate the building with its surroundings, screens HVAC and other utilities and helps create a sense of arrival (Fig.10.6). When developing foundation planting plans consideration should be given Antiterrorism measures (See paragraph 10.11).



Fig. 10.6 - Foundation Plantings Help Screen Utilities

10.5.2.1.1 Focal and seasonal plantings should be located at building entries for pedestrian interest.

10.5.2.1.2 Use the architecture of the building to evaluate the planting design and selection of plants.

10.5.2.1.3 Plant materials should not block windows and views from interior spaces.

10.5.2.1.4 Trees shall be setback from the building walls to provide space for mature growth and to prevent root systems from damaging the foundation.

10.5.2.1.5 A symmetrical foundation planting design should be used for a symmetrical building.

10.5.2.1.6 Due to the possibility of insect problems (bee stings, etc.) do not plant flowering plants near entrances.

### 10.5.2.2 Screening.

**10.5.2.2.1 Windscreens.** Use a combination of evergreen and deciduous trees to provide windbreak protection from prevailing winds. Windbreak plantings should be irregular in form, rather than straight and evenly spaced, in order to provide more effective wind control and to visually blend with the Post's natural character.

**10.5.2.2.2 Screening of Dumpsters.** Landscape planting should be used to supplement wood fence and masonry wall dumpster enclosures (Fig. 10.7).

**10.5.2.3 Buffer Planting.** Use a mixture of evergreen and deciduous trees and shrubs to visually separate land uses and to help separate visual zones.

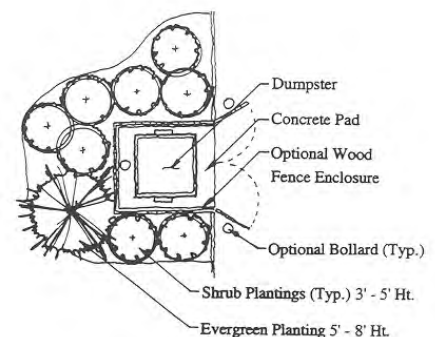


Fig. 10.7 - Screen Dumpsters

**10.5.2.4 Open Space Planting.** Enhance open space areas with planting. Use a mix of evergreen, deciduous, and flowering trees. Plant the same kind of trees in massive groupings to impact the vast open areas (Fig. 10.8).

**10.5.2.5 Street Trees.** Street tree plantings should be used to reinforce vehicular hierarchy, orient and direct traffic, upgrade views and to visually de-emphasize on-street parking (Fig. 10.9). Also, in the design of a street tree planting, separate plant species may be used to identify distinctive details or areas, for example, a particular land use relationship, historical district, community area or other similar entity.



Fig. 10.8 - Enhance Open Spaces with Plantings

**10.5.2.5.1** Use formal street trees in single rows to visually reinforce primary and secondary roads. Use regularly spaced and uniformly shaped deciduous trees to provide a regimented appearance.

**10.5.2.5.2** Use informal groupings of street trees along tertiary routes. Utilize medium size deciduous trees to screen on-street parking along roadways. Set trees 1 to 2 meters (3 to 6 feet) from the back of curbs (Fig. 10.10). Spacing should be uniform, except where curb cuts interrupt regular spacing.

**10.5.2.5.3** As a general rule, street trees should be deciduous species, resistant to salt and root pressure, and should have a 10' to 12' high clearance between the street pavement and branch height to allow adequate clearance for pedestrian and vehicle traffic to pass unimpeded by lower branches.

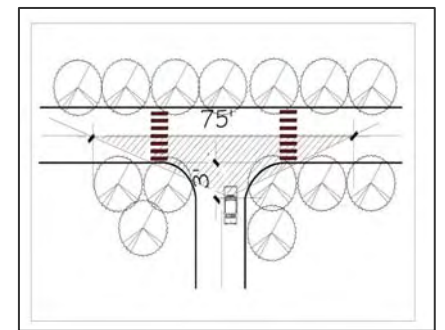


Fig. 10.9 - Use Street Trees to Visually Reinforce Roadway Hierarchy

**10.5.2.5.4** The street tree layout should be coordinated with the layout of proposed street lighting.

**10.5.2.5.5** Appropriate plant heights should be used within sight triangles to ensure safe views from intersections.

**10.5.2.5.6** Weeping trees should not be used in locations where they may hang over the roadway or block views.

**10.5.2.6 Parking Lot Planting.** Parking lots are often the least attractive elements on a military installation. The use of landscape plant material and earth berms can greatly improve the appearance of these areas as well as help define circulation and reduce heat gain during summer months (Fig. 10.10).

**10.5.2.6.1** Use shade tree plantings at parking lots to reduce glare and moderate ambient air temperatures on the lot. Optimum spacing of parking lot shade trees is 10 to 12 meters (35 to 40 feet) on center.

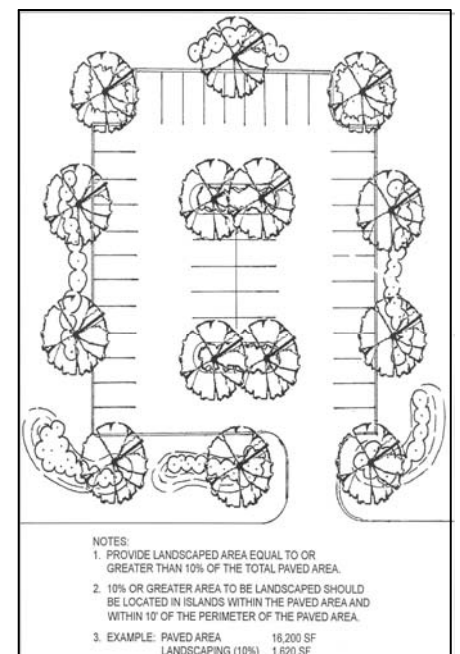


Fig. 10.10 - Provide Parking Lot Planting to Reduce Heat Gain



10.5.2.6.2 Choose trees and shrubs that require minimum maintenance and will not litter the parking area with leaves, fruit, or nuts.

10.5.2.6.3 Consider sight distances near entrances and exits when selecting and placing plant material.

10.5.2.6.4 Select trees, shrubs, and ground covers that can withstand harsher conditions, such as sun, glare, heat, and reduced water supply.

10.5.5.6.5 Use a mix of evergreen and deciduous plant material to screen parking areas from adjacent uses.

10.5.2.7 Environmental Control Planting. When properly placed, plants can provide environmental benefits, as well as address visual concerns.

10.5.2.7.1 Use deciduous trees and shrubs at courtyards, buildings and along streets to provide shade, moderate temperatures and reduce glare during the summer months while allowing solar exposure in the winter.

10.5.2.7.2 Locate deciduous plantings on the southeast and southwest corner of buildings or courtyards to mitigate solar radiation and glare due to heat build-up and lower sun angles in the mid-morning and late afternoon hours.

10.5.2.7.3 Use mixed massings of deciduous shrubs and evergreen trees and shrubs to provide sound control along primary and secondary roads.

10.5.2.8 Image Planting. The image of Fort Sill is formed by the visual impressions that exist within the installation. The primary locations of highly visible images are the main gate, along primary circulation systems, and at areas of high concentrations of people. Features such as signs, statues, static displays, and other primary visual images can be improved by the use of trees, shrubs, and ground cover.

10.5.2.9 Entrances to the Installation. The entrances and streetscapes are areas to place landscaping that will develop a strong visual image and provide visual interest during all four seasons. The entrance to any installation creates the first visual impression for the visitor (Fig. 10.11).

10.5.2.9.1 The landscape materials and planting areas should be proportional in scale to the hierarchy of the street on which they are located.

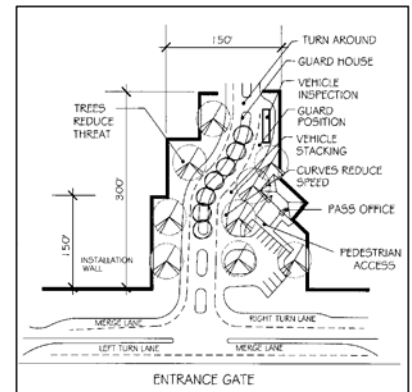


Fig. 10.11 - Landscaping at Entrance Gates will Meet AT/FP Requirements

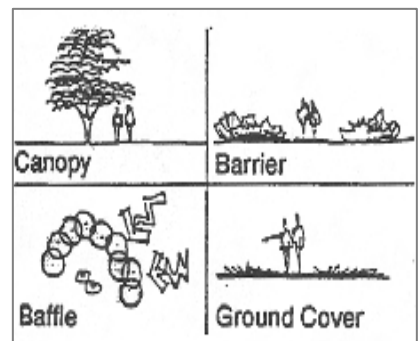


Fig. 10.12 - Basic Design Categories

10.5.2.9.2 Landscaping must be integrated with the Force Protection requirements of Section 12. Low shrubs, groundcover, annual/perennial plants and canopy trees provide seasonal interest as well as maintain views required to ensure force protection measures. Large evergreen trees are discouraged in these locations because they may obstruct sightlines and impact the need for force protection. Adequate lines of sight must be maintained for guard personnel to observe vehicular and pedestrian traffic approaching the gate.

10.5.2.10 Zeroscaping. Where appropriate, to conserve water and lower maintenance, consider zeroscaping.

10.5.2.11 Xeriscape. Xeriscape is the conservation of water and energy through creative and adaptive landscape design. Xeriscape landscapes provide attractive solutions that save money, water, and maintenance. The following website provides guidance on specific design principles of the xeriscape design process and xeriscape design application:

10.6 PLANT MATERIAL SELECTION

10.6.1 Trees, shrubs, ground cover and turf are the major elements of a planting composition. Basic plant selection criteria should consider creating a unified composition utilizing native materials for low maintenance and sustainability, avoiding incompatible colors, textures and forms, and matching the appropriate plant to the land use, situation and environmental condition.

10.6.2 The ability of plant material to provide lasting benefit is dependent upon the plant's hardiness and its appropriateness to the site use. Major factors affecting plant hardiness are soil type and organic content, temperature, moisture and light. These climatic conditions can be modified to an extent by specific site conditions, such as wind protection, solar orientation and planting design, to create microclimates.

10.6.3 Selecting appropriate plants for a given condition is only one aspect of planting design. Compositional arrangement to provide texture variety and to accent site and building features is another. The selection and composition of a planting design requires an understanding of each plant's characteristics, form, and environmental needs as well as how each plant can relate to and complement other plants in the design. Plants are used in four basic

**Plant Categories**

**Cultural Characteristics**

Growth Rate–Rapid

Growth Rate–Medium

Growth Rate–Slow

Disease/Pest Resistance

**Environmental Characteristics**

Acidic Soil Tolerant

Alkaline Soil Tolerant

Dry Soil Tolerant

Moist Soil Tolerant

Poor/Rocky Soil Tolerant

Salt Tolerant

Shade Tolerant

Summer Wind Tolerant

Urban Condition Tolerant

**Ornamental Characteristics**

Blue Flowers

Ornamental Bark

Fig. 10.13 – Plant Categories

design categories (Fig 10.12):

- Canopy
- Barrier
- Screen (or Baffle)
- Groundcover

10.7 PLANT PALETTE AND PLANT CATEGORIES

10.7.1 The plant palette and categories are designed to help the designer choose the best plant for each particular set of design requirements. The plants that appear on the palette and in the categories were selected for their hardiness and their ability to survive in this geographical area. To use them effectively, the design requirements must be well defined for the specific site.

10.7.2 The Plant Palette.

10.7.2.1 A select group of plant materials has been divided into the following six categories:

- deciduous trees
- coniferous trees
- deciduous shrubs
- coniferous shrubs
- broadleaf evergreen shrubs
- groundcover and vines

10.7.2.2 On the palette, the plants appear in alphabetical order by their botanical name, followed by their common name, design characteristics, cultural information, recommended use and miscellaneous notes. The plant palette is presented in a matrix format in the Plant Palette schedule.

10.7.3 The Plant Categories.

10.7.3.1 Plants from the plant palette with similar characteristics have been cataloged in the Plant Categories (Fig. 10.13). These characteristics could be cultural (e.g., upright, narrow form),

**Plant Categories Cont.**

**Ornamental Characteristics**

Pink/Purple Flowers

Red/Crimson Flowers

White/Cream Flowers

Yellow/Orange Flowers

Yellow/Orange/Red Fall Color

**Functional Characteristics**

Erosion Control/Bank Stabilizer

Foundation Plants

Large Hedges (+25')

Medium Hedges (10–20')

Low Hedges (4–10')

**Naturalizing/Conservation**

Park Trees

Large Street Trees (+35')

Small Trees (15–35')

Fig. 10.13 – Plant Categories

environmental (e.g., shade tolerant), ornamental (e.g., red fall color), or functional (e.g., screening plant). Characteristics include: Cultural Conditions (mature height and spread, form and growth rate, disease and pest resistance), Environmental Conditions (sun/shade, pH range, soil moisture required, and wind/sun), and Ornamental Characteristics (flower color, autumn color, fruit color, and/or summer leaf color).

10.7.3.2 Each category describes a list of plants that share a similar quality. For example, materials that are shade tolerant would be placed in the Shade Tolerant group under the "Environmental Conditions" heading. To further explain the Categories, under the "Environmental Conditions" heading, in the Shade Tolerant group, all shade tolerant deciduous trees would be listed under "Deciduous Trees"; all shade tolerant Coniferous trees would be listed under "Coniferous Trees"; and so on.

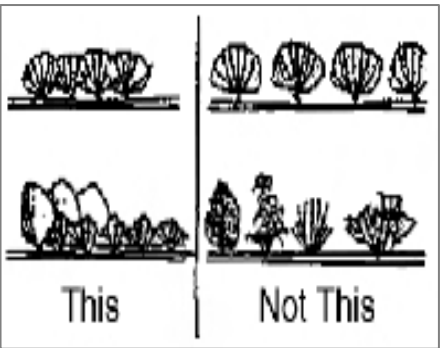


Fig. 10.15 – Space Plants According to their Mature Size



**PLANT PALETTE SCHEDULE**

PLANT SELECTION LIST

Plant Material Suitability Matrix

| PLANT SELECTION LIST<br>Plant Material Suitability Matrix |                   | Type        |           | Growth          |               |                | Flower |        |        | Interest |      |         | Light |            |     | Salt Tolerant |        |      | Resistant |      | Soil Moisture |         |     | Function    |            |        |         |           |       |            |          |   |  |
|---|-------------------|-------------|-----------|-----------------|---------------|----------------|--------|--------|--------|----------|------|---------|-------|------------|-----|---------------|--------|------|-----------|------|---------------|---------|-----|-------------|------------|--------|---------|-----------|-------|------------|----------|---|--|
|   |                   | Deciduous   | Evergreen | Slow            | Medium        | Fast           | Fall   | Summer | Spring | Flower   | Bark | Foliage | Shade | Sun /shade | Sun | Low           | Medium | High | Drought   | Pest | Moist         | Average | Dry | Street tree | Shade tree | Screen | Massing | Windbreak | Hedge | Bank cover | Specimen |   |  |
| Botanical Name  |                   | Common Name |           | Characteristics |               |                |        |        |        |          |      |         |       |            |     | Culture       |        |      |           |      |               | Use     |     |             |            |        |         |           |       |            |          |   |  |
| SHADE TREES   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| Acer saccharum  | Caddo Maple       | X           |           |                 | 75 H<br>50 S  |                | NA     | NA     | NA     |          |      | X       |       | X          |     | X             |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| Plantanus occidentalis                                    | Sycamore          | X           |           |                 |               | 100 H<br>100 S | NA     | NA     | NA     |          | X    | X       | X     |            |     |               | X      |      |           | X    |               |         |     |             | X          |        |         |           |       |            |          |   |  |
| Quercus rubra   | Red Oak           | X           |           |                 |               | 75 H<br>75 S   | NA     | NA     | NA     |          |      |         |       | X          | X   |               | X      |      | X         |      |               | X       |     | X           | X          | X      | X       | X         |       |            |          |   |  |
| Quercus rubra   | Northern Red Oak  | X           |           |                 |               | 75 H<br>75 S   | NA     | NA     | NA     |          |      |         |       | X          | X   |               | X      |      | X         |      |               | X       |     | X           | X          | X      | X       | X         |       |            |          |   |  |
| Quercus shumardi  | Shumard Oak       | X           |           |                 |               | 60 H<br>100 S  | NA     | NA     | NA     |          |      | X       |       | X          |     |               | X      |      | X         |      |               | X       |     |             | X          | X      | X       | X         | X     |            |          |   |  |
| Ulmus parvifolia  | Lacebark Elm      | X           |           |                 | 60 H<br>40 S  |                | NA     | NA     | NA     |          | X    |         |       | X          | X   |               | X      |      | X         | X    | X             | X       |     | X           | X          | X      | X       | X         |       |            |          |   |  |
|   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| INTERMEDIATE TREES (FLOWERING)                            |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| Acer rubrum   | Red Maple         | X           |           |                 |               | 80 H<br>60 S   | NA     | NA     | NA     |          |      | X       | X     | X          |     |               | X      |      |           |      | X             | X       |     | X           | X          | X      | X       |           |       |            |          |   |  |
| Lagerstroemia indica                                      | Crape Myrtle      |             |           |                 | 25 H<br>10 S  |                |        | X      | X      | X        |      |         |       | X          |     | X             |        |      |           |      | X             |         | X   |             | X          |        |         | X         |       |            |          | X |  |
| Pyrus calleryana Chanticleer                              | Chanticleer       | X           |           |                 |               | 35 H<br>16 S   |        |        | X      | X        |      |         |       | X          |     | X             |        | X    |           |      | X             | X       | X   | X           |            | X      | X       |           |       |            |          |   |  |
|   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| EVERGREEN TREES   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
| Junpiperus canaert  | Canaert Juniper   |             | X         |                 | 30 H<br>15 S  |                |        |        | X      |          |      | X       |       |            |     |               |        |      | X         |      |               | X       | X   |             |            | X      | X       | X         |       |            |          |   |  |
| Magnolia grandiflora                                      | Southern Magnolia |             | X         |                 | 80 H<br>50 S  |                |        | X      | X      |          |      | X       |       |            |     |               | X      |      |           |      | X             |         |     |             | X          | X      | X       |           |       |            |          |   |  |
| Pinus elliotti  | Slash Pine        |             | X         |                 | 100 H<br>40 S |                | NA     | NA     | NA     |          |      | X       | X     |            |     |               | X      |      |           |      | X             | X       |     |             | X          | X      | X       |           |       |            |          |   |  |
| Pinus nigra   | Austrian Pine     |             | X         | 60 H<br>40 S    |               |                | NA     | NA     | NA     |          |      | X       |       |            | X   |               | X      |      | X         |      |               | X       |     |             | X          | X      | X       |           |       |            |          |   |  |
| Pinus sylvestris  | Scotch Pine       |             | X         |                 | 60 H<br>40 S  |                | NA     | NA     | NA     |          | X    | X       | X     |            |     |               | X      |      | X         |      | X             |         | X   | X           | X          |        | X       | X         | X     |            |          |   |  |
| Quercus virginiana  | Live Oak          |             | X         | 80 H<br>100 S   |               |                | NA     | NA     | NA     |          |      | X       | X     | X          |     |               |        | X    |           |      | X             | X       |     | X           | X          | X      | X       |           |       |            |          | X |  |
|   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |
|   |                   |             |           |                 |               |                |        |        |        |          |      |         |       |            |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |   |  |

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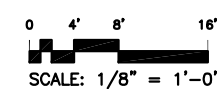


| PLANT SELECTION LIST<br><br>Plant Material Suitability Matrix |  | Type        |           | Growth          |        |      | Flower |             |        | Interest |      |         | Light |           |     | Salt Tolerant |        |      | Resistant |      | Soil Moisture |         |     | Function    |            |        |         |           |       |            |          |  |
|---|--|-------------|-----------|-----------------|--------|------|--------|-------------|--------|----------|------|---------|-------|-----------|-----|---------------|--------|------|-----------|------|---------------|---------|-----|-------------|------------|--------|---------|-----------|-------|------------|----------|--|
|   |  | Deciduous   | Evergreen | Slow            | Medium | Fast | Fall   | Summer      | Spring | Flower   | Bark | Foliage | Shade | Sun/shade | Sun | Low           | Medium | High | Drought   | Pest | Moist         | Average | Dry | Street tree | Shade tree | Screen | Massing | Windbreak | Hedge | Bank cover | Specimen |  |
| Botanical Name  |  | Common Name |           | Characteristics |        |      |        |             |        |          |      |         |       |           |     | Culture       |        |      |           |      |               | Use     |     |             |            |        |         |           |       |            |          |  |
| GROUNDCOVERS/VINES  |  |             |           |                 |        |      |        |             |        |          |      |         |       |           |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |  |
| Lagerstroemia indica  |  | Crapemyrtle |           | X               |        |      |        | 3 H<br>3 S  |        | X        | X    | X       |       |           |     |               | X      |      | X         |      |               |         |     |             |            |        |         | X         |       | X          |          |  |
| Syringa vulgaris  |  | Liliac      |           | X               |        |      |        | 10 H<br>6 S |        |          | X    | X       |       |           |     | X             |        |      | X         |      |               |         |     |             |            |        |         | X         |       | X          |          |  |
| GRASSES   |  |             |           |                 |        |      |        |             |        |          |      |         |       |           |     |               |        |      |           |      |               |         |     |             |            |        |         |           |       |            |          |  |
| Common Bermuda  |  |             |           | X               |        |      |        | X           | NA     | NA       | NA   |         |       | X         |     |               | X      |      |           |      |               |         |     |             |            |        | X       |           |       |            | X        |  |
| Perennial Rye   |  |             |           | X               |        |      |        |             | NA     | NA       | NA   |         |       | X         | X   | X             |        |      |           |      |               |         |     |             |            |        | X       |           |       |            |          |  |
| Tall Fescue   |  |             |           | X               |        |      |        |             | NA     | NA       | NA   |         |       | X         | X   | X             |        |      |           |      |               |         |     |             |            |        | X       |           |       |            | X        |  |

## **Appendix J**

### **Floorplan Drawings**

FORT SILL CENTRAL ISSUE FACILITY  
FLOOR PLAN



- NOTES**
1. ALL BENCHES, ISSUE/TURN-IN AISLE COUNTERS, COMBINATION WORK COUNTER AND CUSTOMER SERVICE COUNTER AT CUSTOMER ASSISTANCE AREA AND ALL OTHER COUNTERS IDENTIFIED IN THE RFP ARE CONTRACTOR FURNISHED, CONTRACTOR INSTALLED ITEMS.
2. CANOPIES SHOWN AT ENTRY DOORS ARE INCLUDED IN THE BASE BID.

## **Appendix K**

### **Fuel Cost Information**

IMSW-SIL-RMO

29 December 2008

## MEMORANDUM FOR Fort Sill Utility and Refuse Customers

SUBJECT: Change of Utility Rate Schedule

1. In compliance with United States Army Center for Public Works, Technical Note 420-41-1, the required annual review of utility cost to the government has been completed. The revised rate will be in effect on your January billing.
2. The FY09 rates are calculated from receipt of FY08 cost experience and completion of year-end reporting. In the event that the rates need to be re-evaluated due to the local market a notice will be sent out immediately.
3. The following rates supersede the rates set forth on all past contract modifications or basic contracts.

|                       | A rate          | B rate          | H rate          |
|-----------------------|-----------------|-----------------|-----------------|
| Electric              | .0611 per KWH   | .0641 per KWH   | .0493 per KWH   |
| Gas                   | 11.9083 per MCF | 12.5037 per MCF | 11.4720 per MCF |
| Water                 | 6.1173 per KGAL | 6.4232 per KGAL | 5.7580 per KGAL |
| Sewage                | 5.3188 per KGAL | 5.5848 per KGAL | 4.2420 per KGAL |
| Refuse                | .0419 per LB    | .0471 per LB    |                 |
| Refuse Rate A per Ton | \$83.87         |                 |                 |
| Refuse Rate B per Ton | \$94.18         |                 |                 |

4. The (A) rate is the cost to the government including operation, privatization and maintenance costs plus losses/infiltration in transmission. Chargeable to other Federal Government activities; applicable DMWR activities and commissaries.
5. The (B) rate is the cost to the government including operation, privatization and maintenance cost, losses/infiltration in transmission, capital charges, and administrative overhead. Chargeable to on post non-federal government activities, lessees of industrial facilities, contractors (MCA, OMA, RDT&E), and direct sales concessionaires. Rate B is also chargeable to off-post non-federal government activities when it is greater than the prevailing rate (LPR) applicable to the customer class.
6. The (H) rate is the cost to the government including normal operation, privatization and maintenance costs plus losses/infiltration in transmission. The maintenance cost excludes major one-time or non-recurring cost maintenance and repair projects (abnormal maintenance). Rate H is chargeable to Army Family Housing and Government employees renting Government quarter's on-post.
7. Point of contact for this action is Kolby Seals (580) 442-3267, IMCOM-RMO, Budget and Accounting Division, Garrison Resource Management Office.



RANDALL J. BUTLER, P.E.  
Director of Public Works

Friday, February 18, 2011

## **Appendix L**

### **LEED Project Credit Guidance**

**APPENDIX L****LEED Project Credit Guidance**

This spreadsheet indicates Army required credits, Army recommendations regarding preference and avoidance of individual credits, project-specific ranking of individual point preferences, discussion of Installation roles in support of individual credits, and issues that Government Project Delivery Teams (PDTs) need to be aware of relating to individual credits. The Resources section that follows provides references and resources that relate to LEED, including policy and legal requirements, design guides and documentation resources.

|   |   |   |   |  |
|---|---|---|---|--|
| LEED 2.2 Credit Paragraph                           |   | Army Guidance: Required - Preferred - Avoid | Project Preference Ranking: (1=most preferred, blank=no preference, X=preference not applicable to this credit, Rqd=required) |  |
|   | LEED Project Credit Guidance                              |   |   |  |
| PAR   | FEATURE   |   |   | REMARKS  |
| CATEGORY 1 - SUSTAINABLE SITES (14 POSSIBLE POINTS) |   |   |   |  |
| SSPR1   | Construction Activity Pollution Prevention (PREREQUISITE) | Rqd   | Rqd   | All LEED prerequisites are required to be met. Related to compliance with 40 CFR 122.26 (Clean Water Act). |
| SS1   | Site Selection  |   | X   | See paragraph LEED CREDITS COORDINATION for information relating to this credit.                           |

|       |   |      |   |  |
|-------|---|------|---|--|
| SS2   | Development Density & Community Connectivity - OPTION 1 DENSITY               |      | X | Credit is determined by Installation's site selection. See paragraph LEED CREDITS COORDINATION for information relating to this credit.                    |
|       | Development Density & Community Connectivity - OPTION 2 CONNECTIVITY          |      | X | Credit is determined by Installation's site selection. See paragraph LEED CREDITS COORDINATION for information relating to this credit.                    |
| SS3   | Brownfield Redevelopment  |      | X | Credit is determined by Installation's site selection. See paragraph LEED CREDITS COORDINATION for information relating to this credit.                    |
| SS4.1 | Alternative Transportation: Public Transportation Access                      |      | X | Credit is determined by Installation's site selection. See paragraph LEED CREDITS COORDINATION for information relating to this credit.                    |
| SS4.2 | Alternative Transportation: Bicycle Storage & Changing Rooms                  | Pref |   |  |
| SS4.3 | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1 |      |   | Requires provision of vehicles, which cannot be purchased with construction funds. Assume Government will not provide vehicles unless indicated otherwise. |
| SS4.3 | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2 | Pref |   |  |
| SS4.3 | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3 |      |   | Requires provision of vehicle refueling stations. Installation must support type of fuel and commit to maintaining/supporting refueling stations.          |
| SS4.4 | Alternative Transportation: Parking Capacity                                  | Pref |   |  |
| SS5.1 | Site Development: Protect or Restore Habitat                                  |      |   |  |
| SS5.2 | Site Development: Maximize Open Space   | Pref |   | Assume AGMBC option for aggregated open space at another location on the installation is not available to the project unless indicated otherwise.          |
| SS6.1 | Stormwater Design: Quantity Control   | Pref |   | Related to compliance with 40 CFR 122.26 (Clean Water Act).  |



|  |   |      |     |   |
|--|---|------|-----|---|
| SS6.2  | Stormwater Design: Quality Control                                      |      |     |   |
| SS7.1  | Heat Island Effect: Non-Roof  | Pref |     |   |
| SS7.2  | Heat Island Effect: Roof  | Pref | 1   | Coordinate with nearby airfield requirements, which may preclude this credit.   |
| SS8  | Light Pollution Reduction   | Pref |     |   |
| <b>CATEGORY 2 – WATER EFFICIENCY (5 POSSIBLE POINTS)</b>       |   |      |     |   |
| WE1.1  | Water Efficient Landscaping: Reduce by 50%                              | Pref |     | Project must include landscaping to be eligible for this credit.  |
| WE1.2  | Water Efficient Landscaping: No Potable Water Use or No Irrigation      | Pref |     | Project must include landscaping to be eligible for this credit.  |
| WE2  | Innovative Wastewater Technologies - OPTION 1                           |      |     |   |
| WE2  | Innovative Wastewater Technologies - OPTION 2                           |      |     |   |
| WE3.1  | Water Use Reduction: 20% Reduction                                      | Pref |     | Related to Army mandate for waterless urinals beginning FY10.   |
| WE3.2  | Water Use Reduction: 30% Reduction                                      | Pref |     |   |
| <b>CATEGORY 3 – ENERGY AND ATMOSPHERE (17 POSSIBLE POINTS)</b> |   |      |     |   |
| EAPR1  | Fundamental Commissioning of the Building Energy Systems (PREREQUISITE) | Rqd  | Rqd | All LEED prerequisites are required to be met.  |
| EAPR2  | Minimum Energy Performance (PREREQUISITE)                               | Rqd  | Rqd | All LEED prerequisites are required to be met.  |
| EAPR3  | Fundamental Refrigerant Management (PREREQUISITE)                       | Rqd  | Rqd | All LEED prerequisites are required to be met.  |
| EA1  | Optimize Energy Performance   | Rqd  | Rqd | Earning of LEED EA1 points as indicated in paragraph ENERGY CONSERVATION, as a minimum, is required. Note that LEED points calculation is based on energy cost reduction. Additional consideration will be given to proposals that exceed the minimum requirements in this credit category. |

|  |  |     |     |  |
|--|--|-----|-----|--|
| EA2.1  | On-Site Renewable Energy   |     |     |  |
| EA3  | Enhanced Commissioning   | Rqd | Rqd | Efforts to obtain this credit must begin early in the design process.  |
| EA4  | Enhanced Refrigerant Management                                  |     |     |  |
| EA5  | Measurement & Verification                                       |     |     | Credit relates to EPACT metering requirements. Provider and funding of post-occupancy activities must be coordinated. Assume Government will not provide post-occupancy activities unless indicated otherwise. |
| EA6  | Green Power  |     | X   | Credit is determined by Installation's purchase of green power. See paragraph LEED CREDITS COORDINATION for information relating to this credit.   |
| <b>CATEGORY 4 – MATERIALS AND RESOURCES (13 POSSIBLE POINTS)</b> |  |     |     |  |
| MRPR1  | Storage & Collection of Recyclables (PREREQUISITE)               | Rqd | Rqd | All LEED prerequisites are required to be met. Installation provides collection service and outside receptacle needs coordination.   |
| MR1.1  | Building Reuse: Maintain 75% of Existing Walls, Floors & Roof    |     |     |  |
| MR1.2  | Building Reuse: Maintain 95% of Existing Walls, Floors & Roof    |     |     |  |
| MR1.3  | Building Reuse: Maintain 50% of Interior Non-Structural Elements |     |     |  |
| MR2.1  | Construction Waste Management: Divert 50% From Disposal          | Rqd | 1   | See paragraph CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT for project requirement.  |

|   |   |      |     |  |
|---|---|------|-----|--|
| MR2.2   | Construction Waste Management:<br>Divert 75% From Disposal            | Pref |     |  |
| MR3.1   | Materials Reuse: 5%   |      |     |  |
| MR3.2   | Materials Reuse: 10%  |      |     |  |
| MR4.1   | Recycled Content: 10% (post-consumer + 1/2 pre-consumer)              | Pref |     | Relates directly to EPA CPG compliance. Federal regulation as well as Federal, DOD and Army policies require purchase of products that contribute to this credit.  |
| MR4.2   | Recycled Content: 20% (post-consumer + 1/2 pre-consumer)              | Pref |     | Relates directly to EPA CPG compliance.  |
| MR5.1   | Regional Materials:10% Extracted, Processed & Manufactured Regionally |      |     |  |
| MR5.2   | Regional Materials:20% Extracted, Processed & Manufactured Regionally |      |     |  |
| MR6   | Rapidly Renewable Materials   |      |     | Relates directly to USDA FB4P biobased materials compliance.   |
| MR7   | Certified Wood  | AVD  | AVD | This credit brings very little value to U.S. Army and should only be considered if there is VERY little wood on the entire project, and can be implemented at nominal or no cost premium.  |
| <b>CATEGORY 5 – INDOOR ENVIRONMENTAL QUALITY (15 POSSIBLE POINTS)</b> |   |      |     |  |
| EQPR1   | Minimum IAQ Performance (PREREQUISITE)                                | Rqd  | Rqd | All LEED prerequisites are required to be met. Related to compliance with 10 CFR 434 (Federal Energy Code).  |
| EQPR2   | Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)              | Rqd  | Rqd | All LEED prerequisites are required to be met. Assume all buildings are smoke free unless indicated otherwise. Family housing, barracks and other lodging are facility types where smoking may be permitted in some cases. If Statement of Work indicates smoking is permitted in these types of facilities, the requirements of LEED-NC 2.2 Option 3 apply. |
| EQ1   | Outdoor Air Delivery Monitoring                                       |      |     |  |

|   |   |      |     |  |
|---|---|------|-----|--|
| EQ2   | Increased Ventilation                                       |      |     | May adversely effect ability to earn energy optimization credits.  |
| EQ3.1   | Construction IAQ Management Plan: During Construction       | Pref |     |  |
| EQ3.2   | Construction IAQ Management Plan: Before Occupancy          | Pref |     | Construction schedule must accommodate activities required for this credit.  |
| EQ4.1   | Low Emitting Materials: Adhesives & Sealants                | Pref |     |  |
| EQ4.2   | Low Emitting Materials: Paints & Coatings                   | Pref |     |  |
| EQ4.3   | Low Emitting Materials: Carpet Systems                      | Pref |     |  |
| EQ4.4   | Low Emitting Materials: Composite Wood & Agrifiber Products | Pref |     |  |
| EQ5   | Indoor Chemical & Pollutant Source Control                  | Pref |     | System requiring weekly cleaning to earn this credit is not a permitted option for Army projects.  |
| EQ6.1   | Controllability of Systems: Lighting                        |      |     |  |
| EQ6.2   | Controllability of Systems: Thermal Comfort                 |      |     |  |
| EQ7.1   | Thermal Comfort: Design                                     |      |     |  |
| EQ7.2   | Thermal Comfort: Verification                               |      |     | Project must earn credit EQ7.1 to be eligible for this credit. Assume Government will not provide post-occupancy activities unless indicated otherwise.  |
| EQ8.1   | Daylight & Views: Daylight 75% of Spaces                    | Pref | 1   | Incorporation of this credit should be coupled with photo-dimming sensors to reduce energy usage, taking care not to incur unwanted solar gain or radiant loss in cooling or heating climates, respectively. |
| EQ8.2   | Daylight & Views: Views for 90% of Spaces                   | Pref | 1   |  |
|   |   |      |     |  |
| <b>CATEGORY 6 – FACILITY DELIVERY PROCESS (5 POSSIBLE POINTS)</b> |   |      |     |  |
| IDc1.1  | Innovation in Design  |      |     |  |
| IDc1.2  | Innovation in Design  |      |     |  |
| IDc1.3  | Innovation in Design  |      |     |  |
| IDc1.4  | Innovation in Design  |      |     |  |
| IDc2  | LEED Accredited Professional                                | Rqd  | Rqd | LEED AP during design and construction is  |

|  |  |  |  |           |
|--|--|--|--|-----------|
|  |  |  |  | required. |
|  |  |  |  |           |

**Resources.** Following are resources with web links, discussion of Federal and Army mandates and policies that relate to LEED, sources of design guidance and documentation tools to assist the PDT. Use of/compliance with documents indicated in this appendix is not required unless indicated in RFP. In the event of conflict between RFP and this appendix, RFP takes precedence.

### **Federal Mandates**

EPA, *Environmentally Preferable Purchasing (EPP) Program* (EPA), available through URL: <http://www.epa.gov/oppt/epp/>. Resulting from Executive Order [EO] 13101 *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition* (White House, 14 September 1998), it establishes basic guidelines for EPP as well as forms the basis for Comprehensive Procurement Guidelines (see below).

#### **Comprehensive Procurement Guidelines [CPG], [www.epa.gov/cpg](http://www.epa.gov/cpg).**

The EPA publishes the Comprehensive Procurement Guidelines (CPGs), found in 40 CFR 247, that provide a list of products that must contain recovered material. **This is required regardless of whether the LEED recycled content credit is pursued or not.** Recommendations for the percentages of recovered materials are published in a companion document titled the Recovered Materials Advisory Notice (RMAN). Additional products are added every 2-3 years. The CPGs currently include several commonly used construction products (such as concrete, floor tiles, and roofing materials) and landscaping products (such as site furnishings and landscaping timbers).

EPA requires that the purchase of products listed on the CPG contain at least the recycled content indicated in the CPG when practicable. For every project, designer must review the current CPG list and, unless designer determines that justification for non-use exists, ensure that the technical specifications require at least the recycled content indicated in the CPG. The following are considered adequate justifications for non-use:

- a. The product does not meet appropriate performance standards.
- b. The product is not available within a reasonable time frame.
- c. The product is not available competitively (from two or more sources).
- d. The product is only available at an unreasonable price (compared with a comparable non-recycled content product).

Applicable FAR provisions and clauses: FAR Part 23.4, *Use of Recovered Materials*, 52.223-4, *Recovered Material Certification*, 52.223-9, *Estimate of Percentage of Recovered Material Content for EPA-Designated Products*. Note that although EPA designated recycled content products contribute to the LEED recycled content credit, satisfying this requirement does not guarantee that the project will reach the cumulative total required to earn the LEED credit.

#### **USDA Federal Biobased Products Preferred Procurement Program (FB4P)**

<http://www.biobased.oce.usda.gov>

The USDA has a program similar to the EPA CPG, found in 7 CFR 2902, that provides a list of designated products that must contain bio-based material with recommendations for the percentages of bio-based content. The rules for use of designated products are the same as EPA CPG. Currently the only designated construction product is roof coatings, however additional products may be added. For every project, designer must review the current USDA designations for products applicable to the project and, if any are found, unless designer determines that justification for non-use exists, ensure that the technical specifications require at least the bio-based content indicated in the designation.

All Federal contracts that involve the use or purchase of USDA- designated products must specify that the associated procurement requirements be met and must include applicable FAR provisions and clauses (currently not yet published). Note that although USDA designated bio-based content products contribute to

the LEED rapidly renewable materials credit, satisfying this requirement does not guarantee that the project will reach the cumulative total required to earn the LEED credit.

### **Army Policy and Mandates**

**ECB 2006-7R** Army Standard for Urinals (09 AUG2006) [www.hnd.usace.army.mil/techinfo](http://www.hnd.usace.army.mil/techinfo) "Publications", "Engineering and Construction Bulletins". Mandates waterless urinals beginning FY10.

### **United States Green Building Council/LEED**

USGBC Website – <http://www.usgbc.org>

LEED-NC (New Construction) v.2.2 Rating System, October 2005 --  
<https://www.usgbc.org/ShowFile.aspx?DocumentID=1095>

LEED-NC v.2.2 Registered Project Checklist --  
[https://www.usgbc.org/FileHandling/show\\_general\\_file.asp?DocumentID=1096](https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1096)

LEED-NC v.2.2 Reference Guide – Available by purchase from the USGBC at:  
<http://www.usgbc.org/b2c/b2c/mainFS.jsp>

LEED Letter Templates – Use of LEED Letter Templates for projects not registered with USGBC is a copyright infringement and is not permitted. Samples of the templates are available for review only at: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1447>. (Fully functional access to LEED On-Line is only available to projects registered with the USGBC.)

LEED Credit Interpretations (CIRs) – Available on the members only side of the USGBC website. Click 'My Account' from the USGBC main web page (log-in and look for CIRs under 'My Resources.'

LEED Application Guide for Multiple Buildings and On-Campus Building Projects  
[https://www.usgbc.org/FileHandling/show\\_general\\_file.asp?DocumentID=1097](https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1097). Provides direction in applying LEED-NC v2.1 and v2.2 to projects in a campus or multi-building setting such as corporate campuses, college campuses, and government installations (i.e. there is one owner or common property management and control).

### **General Resources**

#### **Unified Facilities Guide Specifications (UFGS) [www.wbdg.org/ccb](http://www.wbdg.org/ccb)**

UFGS are non-proprietary guide specifications covering a broad range of products and systems and incorporating agency-specific guidance and many sustainability updates. They are used and maintained by USACE, NAVFAC, AFCEA and NASA.

UFGS are in the process of being updated to include Specifier notes relating to all current EPA CPG product designations, but this process is not complete yet. Designer MUST address EPA CPG requirements in specifications on a product-by-product basis.

UFGS 01 33 29 *LEED™ Documentation*. This section includes overview and documentation requirements plus credit-specific requirements.

UFGS 01 62 35 *Recycled/Recovered Materials*. This section addresses EPA CPG compliance requirements.

UFGS 02 42 00 *Construction and Demolition Waste Management*. For DB and DBB use. This section includes requirement for waste management plan, diversion requirements and reporting.

UFGS 23 08 00.00 10 *Commissioning of HVAC Systems*. This section includes qualifications, standards and documentation, also includes several test checklists. Because it is limited to HVAC only it **does not** by itself satisfy the LEED fundamental commissioning requirement. Commissioning of other LEED required systems and coordination of documentation associated with this additional commissioning must be addressed.

### **USACE LEED Credit Documentation Tools**

**LEED 2.2 Documentation Requirements and Submittals Checklist.** USACE Spreadsheet is available at <http://en.sas.usace.army.mil> to fill in for project submittals.

**Commissioning Plan Document for LEED Fundamental Commissioning** USACE template available at <http://en.sas.usace.army.mil> to edit to create project-specific document.

**Owners Project Requirements Document for LEED Fundamental Commissioning.** USACE template available at <http://en.sas.usace.army.mil> for Design Agent/Owner to edit to create project-specific document. Completed document should be included in DB RFPs or provided to Design Team at start of design.

**Basis of Design Document for LEED Fundamental Commissioning.** USACE template available at <http://en.sas.usace.army.mil> for Designer of Record to edit to create project-specific document.

## **Appendix M**

### **LEED Owner's Project Requirements**



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# Owner's Project Requirements Document for LEED Fundamental Commissioning

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Project: Central Issue Facility (CIF)

Approved:

\_\_\_\_\_  
Name

\_\_\_\_\_  
Owner's Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name

\_\_\_\_\_  
Design Agent's Representative

\_\_\_\_\_  
Date

---

## Overview and Instructions

The purpose of this document is to provide clear and concise documentation of the Owner's goals, expectations and requirements for commissioned systems, and shall be utilized throughout the project delivery and commissioning process to provide an informed baseline and focus for design development and for validating systems' energy and environmental performance.

The Owner's Project Requirements Document is a required document for LEED Version 3.0 EA Prerequisite 1, Fundamental Commissioning of the Building Energy Systems. It shall be completed by the Corps District/Design Agent based on coordination with the Installation/User/Proponent and shall be approved by the Installation/User/Proponent representative.

Use of this template is not required, nor are there any restrictions on editing of it. It is provided simply as a tool to assist project teams in meeting the documentation requirements for LEED Fundamental Commissioning. The intent of the Owner's Project Requirements Document, per the LEED v3.0 Reference Guide, is to detail the functional requirements of a project and the expectations of the building's use and operation as it relates to commissioned systems. This template contains the basic recommended components indicated in the LEED v3.0 Reference Guide. It should be adapted as needed to suit the project, remaining reflective of the LEED intent.

The Owner's Project Requirements Document should ideally be completed before the start of design and furnished to the design team. It must be completed prior to the approval of Contractor submittals of any commissioned equipment or systems to meet LEED requirements.

Updates to the Owner's Project Requirements Document throughout the course of project delivery shall be made by the Corps District/Design Agent based on decisions and agreements coordinated with and agreed to by the Installation/User/Proponent.

The Owner's Project Requirements Document shall be included in the project's LEED documentation file under EA PR1, Fundamental Commissioning of the Building Energy Systems.

## Owner's Project Requirements Document for LEED Fundamental Commissioning

### Table of Contents

1. Owner and User Requirements
  - Primary Purpose, Program and Use
  - Project History
  - Broad Goals
2. Environmental and Sustainability Goals
  - Energy Efficiency Goals
  - General
  - Siting
  - Building Façade
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3. Indoor Environmental Quality Requirements
  - Intended Use
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  - Accommodations for After-Hours Use
  - Lighting, Temperature, Humidity, Air Quality, Ventilation, Filtration
  - Acoustics
  - Occupant Ability to Adjust System Controls
  - Types of Lighting
4. Equipment and Systems Expectations
  - Space Heating
  - Ventilation
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  - HVAC Controls
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5. Building Occupant and O&M Personnel Requirements
  - Facility Operation
  - EMCS
  - Occupant Training and Orientation
  - O&M Staff Training and Orientation

TABLE 1

## 1. **Owner and User Requirements**

What is the primary purpose, program and use of this project? (Example: office building with data center)

The project objective is to design and construct facilities for the military that are consistent with the design and construction practices used for private sector projects that perform similar functions to the military projects. For example, the Central Issue Facility (CIF) has the same function as a civilian warehouse, therefore, the design and construction practices should be consistent with the design and construction practices used for a similar facility in private industry. These components are more fully described in Paragraph 3 of the Scope of Work in the RFP.

Describe pertinent project history. (example: standard design development)

There is currently no Standard Design for the CIF. It is the intent of Government to issue design-build Request for Proposals (RFPs) under the contracts awarded as a result of this solicitation, which may be used as the basis for subsequent RFPs/task orders at the same or other installations within the region, i.e., "adapt-build" and/or as fully-designed RFP/task orders.

### **Broad Goals**

**What are the broad goals relative to program needs?**

Design objective of the CIF is to provide a flexible facility to support the warehouse storage and administrative functions of the Central Issue Facility to support two separate and distinct customer bases: (1) permanent party Soldiers and (2) student and trainee Soldiers. Goals may also include providing economical facilities that support the functional needs of the installation.

**What are the broad goals relative to future expansion?**

No future expansion is expected with this facility type.

**What are the broad goals relative to flexibility?**

The goal is to allow ready adaptability in response to changes in force structure, equipment and doctrine.

**What are the broad goals relative to quality of materials?**

The government places value in methods that streamline construction, manage labor and other resource constraints in an effort to reduce costs and support an aggressive schedule, including such things as fast-tracking, using factory built modules or assemblies, panelization, pre-cast, tilt-up, standard designs, etc., while meeting contract and quality requirements. It is the Army's objective that these buildings will have a 25-year useful design life before a possible re-use/re-purpose or renovation requirement, to include normal sustainment, restoration, modernization activities and a 50-year building replacement life. Therefore, the design and construction should provide an appropriate level of quality to ensure the continued use of the facility over that period with the application of reasonable preventive maintenance and repairs that would be industry-acceptable to a major civilian sector project owner. Site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles.

**What are the broad goals relative to construction costs?**

Facility must meet budget.

**What are the broad goals relative to operational costs?**

Meet EPACT, EISA, and appropriate Executive Orders (reduced water, energy consumption). Minimize operating costs as much as possible within first cost budget. The project must also meet Engineering and Construction Bulletin No.2010-14 Issued 28 June 2010

**Other broad goals: *(Insert as applicable)***

To provide essentially the same functional facility at all locations (site-adapt) to the extent possible to facilitate unit mobility and to reduce repetitive design costs. To achieve overall program efficiencies and cost reductions using regional task order contracts for each standard. To reduce overall construction time to 18 months or less.

**2. Environmental and Sustainability Goals****What are the project goals relative to sustainability and environmental issues? (example: LEED Silver rating)**

The project is to achieve a LEED Silver rating.

**What are the project goals relative to energy efficiency? (example: Meet EPACT)**

The project goals relative to energy efficiency are to meet EPACT, EISA, appropriate Executive Orders, and ECB2010-14.

**What are the project goals and requirements for building siting that will impact energy use?**

Same facility must be site-adapted nationwide with minimal design effort. Consistent building orientation cannot always be expected. Consider variations in availability of fuel sources. Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**What are the project goals and requirements for building facade that will impact energy use?**

Same facility must be site-adapted nationwide with minimal design effort. Exterior appearance will vary to be compatible with adjoining environment's architectural theme and Antiterrorism/Force Protection requirements. Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**What are the project goals and requirements for building fenestration that will impact energy use?**

Same facility must be site-adapted nationwide with minimal design effort. Fenestration will vary to be compatible with adjoining environment's architectural theme and Antiterrorism/Force Protection requirements. Consistent building orientation cannot be expected at all sites. Antiterrorism/Force Protection criteria (UFC 4-010-01) requires laminated glass and heavy-duty frame. Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**What are the project goals and requirements for building envelope that will impact energy use?**

ASHRAE 90.1 and EPACT are required. Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**What are the project goals and requirements for building roof that will impact energy use?**

Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**Other:** *(Insert as applicable)*

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### **3. Indoor Environmental Quality Requirements**

**What is the intended use for all spaces? For all spaces that have an intended use that is not readily apparent from the space name, provide this information in Table 1.**

The CIF has similar function as a warehouse and administrative area in the private sector; however, it also has a functional requirement for issue counters with immediate access to stocks.

**What is the anticipated occupancy schedule (numbers of occupants and time frames) for all occupied spaces? Indicate the default occupancy schedule below and for all spaces that have an occupancy schedule that differs from the default, provide this information in Table 1.**

Typical occupancy schedule is the normal business workday.

**What accommodations for after-hours use are required? (example: access control, lighting controls, HVAC controls) Indicate general accommodations required below and for all spaces that have special requirements, provide this information in Table 1.**

Accommodations for after-hours will be required. Special local requirements are indicated in Paragraph 6 of the Scope of Work.

**What are the lighting, temperature, humidity, air quality, ventilation and filtration requirements for all spaces? Indicate the default requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.**

Lighting: See the Scope of Work of RFP

Temperature: See the Scope of Work of RFP

Humidity: See the Scope of Work of RFP

Air Quality: See the Scope of Work of RFP

Ventilation: See the Scope of Work of RFP

Filtration: See the Scope of Work of RFP

**What are the acoustical requirements for all spaces? Indicate the default acoustical requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.**

See the Scope of Work of RFP.

**What is the desired level of occupant ability to adjust systems controls? Indicate the default desired levels below and for all spaces that have a desired level that differs from the default, provide this information in Table 1.**

Lighting: See the Scope of Work of RFP

Temperature: See the Scope of Work of RFP

Humidity: See the Scope of Work of RFP

Air Quality: See the Scope of Work of RFP

Ventilation: See the Scope of Work of RFP

**What, if any, specific types of lighting are desired? (example: fluorescent in 2x2 grid, accent lighting, particular lamps)**

Special local requirements are indicated in Paragraph 6 of the Scope of Work. \_\_\_\_\_

#### **4. Equipment and System Expectations**

*(Complete for each category as applicable or indicate "none identified" or "N/A". Add desired features information for other anticipated commissioned systems as applicable)*

##### **Indicate desired features for the following commissioned system: Space Heating**

Desired Type: Gas Fired radiant \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_

Reliability: High \_\_\_\_\_

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: 40% better than ASHRAE 90.1

Desired Technologies: \_\_\_\_\_

##### **Indicate desired features for the following commissioned system: Ventilation**

Desired Type: Meet ASHRAE 62.1

Quality: \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_

Reliability: High \_\_\_\_\_

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: 40% better than ASHRAE 90.1

Desired Technologies: \_\_\_\_\_

##### **Indicate desired features for the following commissioned system: Air Conditioning**

Desired Type: \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_

Reliability: High \_\_\_\_\_

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: 40% better than ASHRAE 90.1

Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: Refrigeration**

Desired Type: R-410A or R-134 or R-123 \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_

Reliability: High \_\_\_\_\_

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: 40% better than ASHRAE 90.1

Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: HVAC Controls**

Desired Type: Trane ES or Schneider Electric \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: Trane ES or Schneider Electric

Reliability: High

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: \_\_\_\_\_

Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: Domestic Hot Water**

Desired Type: Gas Fired \_\_\_\_\_

Quality: High \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_

Reliability: High \_\_\_\_\_

Automation: BACNET or LON

Flexibility: \_\_\_\_\_

Maintenance Requirements: Easy to Maintain

Efficiency Target: 40% better than ASHRAE 90.1, +90%

Desired Technologies: Condensing, pulse, and/or fully modulating. \_\_\_\_\_

**Indicate desired features for the following commissioned system: Lighting Controls**

Desired Type: Per standard design requirements \_\_\_\_\_

Quality: \_\_\_\_\_

Preferred Manufacturer: \_\_\_\_\_  
Reliability: \_\_\_\_\_  
Automation: \_\_\_\_\_  
Flexibility: \_\_\_\_\_  
Maintenance Requirements: \_\_\_\_\_  
Efficiency Target: \_\_\_\_\_  
Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: Day-lighting Controls**

Desired Type: **Per standard design requirements** \_\_\_\_\_  
Quality: \_\_\_\_\_  
Preferred Manufacturer: \_\_\_\_\_  
Reliability: \_\_\_\_\_  
Automation: \_\_\_\_\_  
Flexibility: \_\_\_\_\_  
Maintenance Requirements: \_\_\_\_\_  
Efficiency Target: \_\_\_\_\_  
Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: Emergency Power**

Desired Type: **No emergency generator is required - Coordinate with the user to verify the need to prepare the facility to connect to an Emergency generator.** \_\_\_\_\_  
Quality: \_\_\_\_\_  
Preferred Manufacturer: \_\_\_\_\_  
Reliability: \_\_\_\_\_  
Automation: \_\_\_\_\_  
Flexibility: \_\_\_\_\_  
Maintenance Requirements: \_\_\_\_\_  
Efficiency Target: \_\_\_\_\_  
Desired Technologies: \_\_\_\_\_

**Indicate desired features for the following commissioned system: Other - \_\_\_\_\_**

Desired Type: \_\_\_\_\_  
Quality: \_\_\_\_\_  
Preferred Manufacturer: \_\_\_\_\_  
Reliability: \_\_\_\_\_  
Automation: \_\_\_\_\_  
Flexibility: \_\_\_\_\_  
Maintenance Requirements: \_\_\_\_\_  
Efficiency Target: \_\_\_\_\_  
Desired Technologies: \_\_\_\_\_



### **5. *Building Occupant and O&M Personnel Requirements***

**How will the facility be operated? Who will operate the facility?**

See the Scope of Work of RFP and/or consult with the DPW or Staff.

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**Will the facility be connected to an EMCS? If so, what are the interface requirements? (example: monitoring points, control points, scheduling)**

See the Scope of Work of RFP and/or consult with the DPW or Staff.

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**What is the desired level of training and orientation for building occupants to understand and use the building systems?**

See the Scope of Work of RFP and/or consult with the DPW or Staff.

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**What is the desired level of training and orientation for O&M staff to understand and maintain the building systems?**

See the Scope of Work of RFP and/or consult with the DPW or Staff.

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Table 1

| Space | Use / Activity | Number Occupants | Special Occupancy Schedule | After Hours Use Reqmt. | Special Cooling Reqmt. | Special Heating Reqmt. | Special Humidity Reqmt. | Special Ventil./Filtration Reqmt. | Special Acoustic Reqmt. | Special Lighting Reqmt. | Special Occup Adjustability Reqmt. |
|-------|----------------|------------------|----------------------------|------------------------|------------------------|------------------------|-------------------------|-----------------------------------|-------------------------|-------------------------|------------------------------------|
|       |                |                  |                            |                        |                        |                        |                         |                                   |                         |                         |                                    |

### **LEED Requirements for Multiple Contractor Combined Projects (30 Oct 08)**

When site work and building(s) for a project are accomplished by separate contractors, it is referred to as a Combined Project for purposes of LEED scoring and documentation and the following is required:

- LEED points relating to site work must be combined with the LEED points for each building to arrive at a single LEED Combined Project score.
- LEED points having both building requirements and site requirements (combined bldg/site points) must be coordinated between the contractors.
- LEED aggregate materials points must be coordinated between the contractors and a division of responsibilities for each contractor's required contribution to the point must be developed.
- LEED Project documentation from separate contractors must be combined.

**Multiple Contractor Combined Project Definition.** See paragraph MULTIPLE CONTRACTOR COMBINED PROJECT in paragraph PROJECT SPECIFIC REQUIREMENTS of the Statement of Work to see if this project is part of a Multiple Contractor Combined Project. A summary of the separate projects that constitute the Combined Project may be provided at paragraph SUSTAINABLE DESIGN – ADDITIONAL INFORMATION or may be obtained from the Contracting Officer's Representative. Typical Multiple Contractor Combined Projects are comprised of the site work contract and all the building-only contracts for buildings that the site work is provided for in the separate site work contract.

**LEED Points Coordination.** See Appendix LEED Strategy Table(s) for the total number of points each contractor is responsible for obtaining, for special requirements relating to combined building/site points and for each contractor's requirement relating to aggregate materials points each portion of this Multiple Contractor Combined Project. Each contractor providing a building is referred to as Building CTR and Site CTR refers to the contractor providing the site development. For each building included in the site work contract, the site work contractor is both Building CTR and Site CTR for that building. Aggregate materials percentages indicated in the table(s) are percentage of that contractor's materials total.

**Point Substitutions.** During preparation of the Proposal, each contractor is free to substitute other LEED points for those indicated in the LEED Strategy Table(s), except points marked "NO" in the "Building CTR Substitutions Permitted" column may not be deleted or added by substitution by building contractor and points marked "NO" in the "Site CTR Substitutions Permitted" column may not be deleted or added by substitution by site contractor. Credit substitutions after award are not permitted except with the advance approval of the Contracting Officer.

**LEED Documentation.** Each contractor is responsible for developing all project LEED documentation demonstrating compliance for their portion of the work and must utilize the LEED Letter Templates. Each contractor is responsible for updating construction phase LEED documentation at least monthly until construction closeout. No CTR will duplicate the data of another CTR within their own documentation. Each contractor will include the contractor name, project name and number and individual building description as applicable on each Letter Template. The LEED Letter Templates are copyright protected and shall be used only for this specific contract and this registered project.

**Compiling LEED Documentation from Multiple Contractors.** At completion and acceptance of final design submittals the completed design phase letter templates and their attachments from all CTRs in the Multiple Contractor Combined Project will be compiled at the registered site project. All CTRs will furnish electronic copies of their completed letter templates and their attachments for this purpose. Monthly during construction and at construction closeout all CTRs current construction phase letter templates and their attachments will be compiled at the registered site project. Summary letter templates for all aggregate credits (see AGMBC for which credits are aggregate credits) will be created and maintained monthly with summary data from all from all CTRs in the Multiple Contractor Combined Project at the registered site project. All CTRs will furnish

electronic copies of the current updated templates and their attachments for this purpose monthly and at closeout.

**Site Work Portion of Multiple Contractor Combined Project, Administration by the Government.** If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Government, the Government will provide access to blank Letter Templates for site CTRs use and the Government will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above.

**Site Work Portion of Multiple Contractor Combined Project, Shared Administration.** If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is shared between Contractor and Government, the Contractor will administer the registered site project until final design acceptance, at which point administration will be transferred to the Government. The Government will administer the project during construction and the Government will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above.

**Site Work Portion of Multiple Contractor Combined Project, Administration by the Contractor.** If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Contractor, the Contractor will administer the project and **the Contractor will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above.**

**Standard Design Building(s) portion of Multiple Contractor Combined Project, Administration by the Government.** If paragraph 16.4.2 CREDIT VALIDATION indicates this is a standard design building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Government, the Government will provide access to blank Letter Templates for standard design building CTRs use.

### **Instructions for Obtaining LEED Letter Templates for Registered Army Standard Designs**

**General.** Contractors providing Army standard design buildings only (site work by another contractor) in a Multiple Contractor Combined project obtain their LEED Letter Templates for the project from the Center of Standardization (COS) for that standard design.

**Information You Need to Provide.** After award, contact the COS POC indicated below requesting LEED Letter Templates for your project. In your request, indicate the following:

Project name, location, Contractor name, PN number and contract number

Description of building(s) you are responsible for (example: S/M/L/L COF w/detached admin)

LEED Documentation Responsible Party name, phone number, email contact info

Responsible party certification of understanding that Letter Templates furnished by the Government for this project are copyright protected and will not be used for any purposes other than for this project documentation.

Attach the LEED Registered Project Checklist from conformed proposal which indicates the points the project will earn/contribute to.

It is recommended that you copy the sample below and revise for your project information.

\*\*\*\*\*

#### **SAMPLE EMAIL REQUEST:**

To: (COS POC below)

CC: (Contracting Officer's Representative (COR) for your contract)

Subject: COS LEED Letter Templates Request

We have an awarded contract and request COS LEED Letter Templates for:

**Project:** 4<sup>th</sup> BCT Complex

**Location:** Fort Bragg, NC

Friday, February 18, 2011

**Contractor:** Great Design Builder Inc.  
**Project Number/Contract Number:** PN 65555, W912HN-08-C-0001  
**Standard Design Building Type(s):** Brigade HQ, Battalion HQ

Our **Responsible Party** for LEED Documentation for this project is (name, phone number, email).

**Certification:** I, (sender name), certify that the LEED Letter Templates furnished by the Government for this project are copyright protected and I will ensure that they are not used for any purpose other than project documentation for this project only.

**Attached Checklist:** Please see attached LEED Project Checklist, which indicates the points this project will earn.

Salutation,  
Name  
\*\*\*\*\*

**COS Points of Contact for Obtaining Letter Templates.** Email your request to the applicable POC indicated below. If there is no POC indicated for the standard design you are providing, contact your project COR for direction.

| <u>Army Standard Design</u>                      | <u>Point of Contact</u>  |
|--|--|
| Army Family Housing                              | <a href="mailto:Lisa.A.Bobotas@usace.army.mil">Lisa.A.Bobotas@usace.army.mil</a>       |
| Battalion Headquarters                           | <a href="mailto:judith.f.milton@usace.army.mil">judith.f.milton@usace.army.mil</a>     |
| Brigade Headquarters                             | <a href="mailto:judith.f.milton@usace.army.mil">judith.f.milton@usace.army.mil</a>     |
| Company Operations Facilities (COF)              | <a href="mailto:judith.f.milton@usace.army.mil">judith.f.milton@usace.army.mil</a>     |
| Criminal Investigation Facilities                | <a href="mailto:Matthew.C.Scanlon@usace.army.mil">Matthew.C.Scanlon@usace.army.mil</a> |
| Enlisted Personnel Dining Facilities             | <a href="mailto:David.A.Gary@usace.army.mil">David.A.Gary@usace.army.mil</a>           |
| General Instruction Buildings/Classroom XXI      | <a href="mailto:Huong.M.Huynh@usace.army.mil">Huong.M.Huynh@usace.army.mil</a>         |
| Military Entrance Processing Stations            | <a href="mailto:Lisa.A.Bobotas@usace.army.mil">Lisa.A.Bobotas@usace.army.mil</a>       |
| Tactical Equipment Maintenance Facilities (TEMF) | <a href="mailto:judith.f.milton@usace.army.mil">judith.f.milton@usace.army.mil</a>     |
| Transient Officer's Quarters (part of ORTC)      | <a href="mailto:paul.m.kai@usace.army.mil">paul.m.kai@usace.army.mil</a>               |

**Furnishing Completed Documentation to COS Letter Template Library.** Certain completed design phase letter templates with attachments may be requested by the COS for future use as part of the standard design. If requested, provide an electronic copy to the COS Point of Contact indicated above. The Center of Standardization (COS) for individual Army standard designs may maintain a library of completed LEED documentation for that standard design. The Government will make the completed templates available to subsequent standard design projects in order to reduce duplication of documentation effort to the extent possible. To inquire about reviewing or obtaining completed LEED documentation that may be applicable to a particular project, contact the Center of Standardization POC

|                       |                                |                                     |                                 |                          |   |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|
| LEED Credit Paragraph | <b>LEED 2.2 Strategy Table</b> | Building CTR Substitution Permitted | Site CTR Substitution Permitted | Required Points Strategy | YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed. |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|

**COMPLEX: Central Issue Facility (CIF)**

| PAR                                   | FEATURE   |     |     |   | REMARKS  |
|---------------------------------------|---|-----|-----|---|--|
| <b>CATEGORY 1 – SUSTAINABLE SITES</b> |   |     |     |   |  |
| SSPR1                                 | Construction Activity Pollution Prevention (PREREQUISITE)                     | NIC | NO  | R | Site CTR is primary permittee. Building CTR is secondary permittee to primary permittee.                                       |
| SS1                                   | Site Selection  | NIC | NO  |   | Site CTR responsible.  |
| SS2                                   | Development Density & Community Connectivity                                  | NIC | NO  |   | Site CTR responsible.  |
| SS3                                   | Brownfield Redevelopment  | NIC | NO  |   | Site CTR responsible.  |
| SS4.1                                 | Alternative Transportation: Public Transportation Access                      | NIC | NO  |   | Site CTR responsible.  |
| SS4.2                                 | Alternative Transportation: Bicycle Storage & Changing Rooms                  | NO  | NO  | 1 | Combined Bldg/Site credit. Site CTR responsible for bicycle storage. Building CTR responsible for shower/changing rooms.       |
| SS4.3                                 | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1 | NIC | YES |   | Site CTR responsible.  |
|                                       | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2 | NIC | YES | 1 | Site CTR responsible.  |
|                                       | Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3 | NO  | NO  |   | Combined Bldg/Site credit.   |
| SS4.4                                 | Alternative Transportation: Parking Capacity                                  | NIC | YES | 1 | Site CTR responsible.  |
| SS5.1                                 | Site Development: Protect or Restore Habitat                                  | NIC | YES |   | Site CTR responsible.  |
| SS5.2                                 | Site Development: Maximize Open Space   | NIC | YES | 1 | Site CTR responsible.  |
| SS6.1                                 | Stormwater Design: Quantity Control   | NIC | YES |   | Site CTR responsible.  |
| SS6.2                                 | Stormwater Design: Quality Control  | NIC | YES |   | Site CTR responsible.  |
| SS7.1                                 | Heat Island Effect: Non-Roof  | NIC | YES |   | Site CTR responsible.  |
| SS7.2                                 | Heat Island Effect: Roof  | YES | NIC | 1 | Building CTR responsible.  |
| SS8                                   | Light Pollution Reduction   | NO  | NO  | 1 | Combined Bldg/Site credit. Building CTR responsible for building lighting rqmts. Site CTR responsible for site lighting rqmts. |
| <b>CATEGORY 2 – WATER EFFICIENCY</b>  |   |     |     |   |  |
| WE1.1                                 | Water Efficient Landscaping: Reduce by 50%                                    | NIC | YES | 1 | Site CTR responsible.  |
| WE1.2                                 | Water Efficient Landscaping: No Potable Water Use or No Irrigation            | NIC | YES | 1 | Site CTR responsible.  |

|                       |                                |                                     |                                 |                          |   |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|
| LEED Credit Paragraph | <b>LEED 2.2 Strategy Table</b> | Building CTR Substitution Permitted | Site CTR Substitution Permitted | Required Points Strategy | YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed. |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|

**COMPLEX: Central Issue Facility (CIF)**

| PAR   | FEATURE                                       |     |     |   | REMARKS                    |
|-------|---|-----|-----|---|----------------------------|
| WE2   | Innovative Wastewater Technologies - OPTION 1 | NO  | NO  |   | Combined Bldg/Site credit. |
| WE2   | Innovative Wastewater Technologies - OPTION 2 | NIC | YES |   | Site CTR responsible.      |
| WE3.1 | Water Use Reduction: 20% Reduction            | YES | NIC | 1 | Building CTR responsible.  |
| WE3.2 | Water Use Reduction: 30% Reduction            | YES | NIC |   | Building CTR responsible.  |

**CATEGORY 3 – ENERGY AND ATMOSPHERE**

|       |   |     |     |   |   |
|-------|---|-----|-----|---|---|
| EAPR1 | Fundamental Commissioning of the Building Energy Systems (PREREQUISITE) | NO  | NO  | R | Building CTR responsible for commissioning of building systems. Site CTR responsible for commissioning of site systems. |
| EAPR2 | Minimum Energy Performance (PREREQUISITE)                               | NO  | NIC | R | Building CTR responsible.   |
| EAPR3 | Fundamental Refrigerant Management (PREREQUISITE)                       | NO  | NIC | R | Building CTR responsible.   |
| EA1   | Optimize Energy Performance   | YES | NIC | 6 | Building CTR responsible. Must comply with EPACT  |
| EA2   | On-Site Renewable Energy  | YES | NO  |   | Proposed credit must fall within CTR scope or be coordinated with other CTR.  |
| EA3   | Enhanced Commissioning  | YES | NO  |   |   |
| EA4   | Enhanced Refrigerant Management   | YES | NIC | 1 | Building CTR responsible.   |
| EA5   | Measurement & Verification  | YES | NIC |   | Building CTR responsible.   |
| EA6   | Green Power   | NO  | NIC |   | Building CTR responsible.   |

**CATEGORY 4 – MATERIALS AND RESOURCES**

|       |   |     |     |   |                           |
|-------|---|-----|-----|---|---------------------------|
| MRPR1 | Storage & Collection of Recyclables (PREREQUISITE)            | NO  | NIC | R | Building CTR responsible. |
| MR1.1 | Building Reuse: Maintain 75% of Existing Walls, Floors & Roof | N/A | N/A |   |                           |
| MR1.2 | Building Reuse: Maintain 95% of Existing Walls, Floors & Roof | N/A | N/A |   |                           |

|                       |                                |                                     |                                 |                          |   |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|
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|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|

**COMPLEX: Central Issue Facility (CIF)**

| PAR   | FEATURE   |     |     |   | REMARKS  |
|-------|---|-----|-----|---|--|
| MR1.3 | Building Reuse: Maintain 50% of Interior Non-Structural Elements      | N/A | N/A |   |  |
| MR2.1 | Construction Waste Management: Divert 50% From Disposal               | NO  | NO  | 1 | Combined Aggregate credit. Building CTR responsible for diversion of minimum 50% of waste generated. Site CTR responsible for diversion of minimum 50% of waste generated. |
| MR2.2 | Construction Waste Management: Divert 75% From Disposal               | NO  | NO  |   | Combined Aggregate credit. Building CTR responsible for diversion of minimum 75% of waste generated. Site CTR responsible for diversion of minimum 75% of waste generated. |
| MR3.1 | Materials Reuse: 5%   | NO  | NO  |   | Combined Cumulative credit. Building CTR responsible for 5% materials reuse. Site CTR responsible for 5% materials reuse.  |
| MR3.2 | Materials Reuse: 10%  | NO  | NO  |   | Combined Cumulative credit. Building CTR responsible for 10% materials reuse. Site CTR responsible for 10% materials reuse.  |
| MR4.1 | Recycled Content: 10% (post-consumer + 1/2 pre-consumer)              | NO  | NO  | 1 | Combined Cumulative credit. Building CTR responsible for minimum 15% recycled materials. Site CTR responsible for minimum 1% recycled materials.                           |
| MR4.2 | Recycled Content: 20% (post-consumer + 1/2 pre-consumer)              | NO  | NO  |   | Combined Cumulative credit. Building CTR responsible for minimum 30% recycled materials. Site CTR responsible for minimum 1% recycled materials.                           |
| MR5.1 | Regional Materials:10% Extracted, Processed & Manufactured Regionally | NO  | NO  | 1 | Combined Cumulative credit. Building CTR responsible for minimum 3% regional materials. Site CTR responsible for minimum 30% regional materials.                           |
| MR5.2 | Regional Materials:20% Extracted, Processed & Manufactured Regionally | NO  | NO  |   | Combined Cumulative credit. Building CTR responsible for minimum 6% regional materials. Site CTR responsible for minimum 60% regional materials.                           |
| MR6   | Rapidly Renewable Materials   | YES | NIC |   | Building CTR responsible.  |
| MR7   | Certified Wood  | YES | NIC |   | Building CTR responsible.  |

**CATEGORY 5 – INDOOR ENVIRONMENTAL QUALITY**

|       |  |     |     |   |  |
|-------|--|-----|-----|---|--|
| EQPR1 | Minimum IAQ Performance (PREREQUISITE)                   | NO  | NIC | R | Building CTR responsible.  |
| EQPR2 | Environmental Tobacco Smoke (ETS) Control (PREREQUISITE) | NO  | NO  | R | Smoking is prohibited in non-residential federal facilities. Building CTR responsible for building ETS control features. Site CTR responsible for site ETS features. |
| EQ1   | Outdoor Air Delivery Monitoring                          | YES | NIC |   | Building CTR responsible.  |
| EQ2   | Increased Ventilation                                    | YES | NIC |   | Building CTR responsible.  |
| EQ3.1 | Construction IAQ Management Plan: During Construction    | YES | NIC | 1 | Building CTR responsible.  |
| EQ3.2 | Construction IAQ Management Plan: Before Occupancy       | YES | NIC | 1 | Building CTR responsible.  |
| EQ4.1 | Low Emitting Materials: Adhesives & Sealants             | YES | NIC | 1 | Building CTR responsible.  |
| EQ4.2 | Low Emitting Materials: Paints & Coatings                | YES | NIC | 1 | Building CTR responsible.  |
| EQ4.3 | Low Emitting Materials: Carpet Systems                   | YES | NIC |   | Building CTR responsible.  |



|                       |                                |                                     |                                 |                          |   |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|
| LEED Credit Paragraph | <b>LEED 2.2 Strategy Table</b> | Building CTR Substitution Permitted | Site CTR Substitution Permitted | Required Points Strategy | YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed. |
|-----------------------|--------------------------------|-------------------------------------|---------------------------------|--------------------------|---|

**COMPLEX: Central Issue Facility (CIF)**

| PAR   | FEATURE   |     |     |   | REMARKS                   |
|-------|---|-----|-----|---|---------------------------|
| EQ4.4 | Low Emitting Materials: Composite Wood & Agrifiber Products | YES | NIC | 1 | Building CTR responsible. |
| EQ5   | Indoor Chemical & Pollutant Source Control                  | YES | NIC | 1 | Building CTR responsible. |
| EQ6.1 | Controllability of Systems: Lighting                        | YES | NIC | 1 | Building CTR responsible. |
| EQ6.2 | Controllability of Systems: Thermal Comfort                 | YES | NIC | 1 | Building CTR responsible. |
| EQ7.1 | Thermal Comfort: Design                                     | YES | NIC |   | Building CTR responsible. |
| EQ7.2 | Thermal Comfort: Verification                               | YES | NIC |   | Building CTR responsible. |
| EQ8.1 | Daylight & Views: Daylight 75% of Spaces                    | YES | NIC | 1 | Building CTR responsible. |
| EQ8.2 | Daylight & Views: Views for 90% of Spaces                   | YES | NIC | 1 | Building CTR responsible. |

**CATEGORY 6 – FACILITY DELIVERY PROCESS**

|        |                              |     |     |    |   |
|--------|------------------------------|-----|-----|----|---|
| IDc1.1 | Innovation in Design         | YES | YES |    | Proposed credit must fall within CTR scope or be coordinated with other CTRs. |
| IDc1.2 | Innovation in Design         | YES | YES |    | Proposed credit must fall within CTR scope or be coordinated with other CTRs. |
| IDc1.3 | Innovation in Design         | YES | YES |    | Proposed credit must fall within CTR scope or be coordinated with other CTRs. |
| IDc1.4 | Innovation in Design         | YES | YES |    | Proposed credit must fall within CTR scope or be coordinated with other CTRs. |
| IDc2   | LEED Accredited Professional | NO  | NO  | 1  |   |
|        |                              |     |     |    |   |
|        | TOTAL                        |     |     | 30 |   |
|        |                              |     |     |    |   |
|        |                              |     |     |    |   |

## APPENDIX P

### LEED Registration of Army Projects

15 April 2010

#### **Number of Registrations**

Each building must be registered separately, except multiple instances of a standard building on a shared site may be registered as a single project. If a single registration for multiple buildings is chosen, all buildings under the single registration must earn exactly the same points. Do not register buildings that are exempt from a specific LEED achievement requirement.

#### **Typical Registration Procedure**

1. Login, complete the online registration form (see guidance below) at the GBCI LEED Online website <http://www.gbci.org/DisplayPage.aspx?CMSPageID=174> and submit it online.
2. Pay the registration fee via credit card (USACE staff: credit card PR&C is funded by project design or S&A funds).
3. GBCI will follow up with a final invoice, the LEED-online passwords and template information.
4. The individual who registers the project online is, by default, the Project Administrator.

#### **Completing the Registration Form**

##### **BEFORE YOU BEGIN:**

**Create a personal account with USGBC if you do not have one.**

**You will need the following information:**

**Project name as it appears in P2 (obtain from USACE Project Manager)**

**Building number/physical address of project**

**Zip code for Installation/project location**

**Anticipated construction start and end dates**

**Total gross area all non-exempt buildings in registration**

**Total construction cost all non-exempt buildings only (see Project Details Section instructions below)**

##### **ACCOUNT/LOGIN INFORMATION**

1. The person registering the project **must have an account with USGBC** (login and password) to complete the form. Go to <http://www.gbci.org/>, click on "register a project" at the drop-down menu for project certification (at the top of the page) and select "register now for LEED 2009" to start the project registration process. If you have an account, login with your email address and password and select "register new project" to proceed. If you do not have an account, you may select "register a new account" and follow the instructions. It is recommended that you create an account separately on the USGBC website before you start the form. IMPORTANT: USACE team members are members of USGBC and are eligible for Member prices. USACE team members registering projects should be sure to include the USACE Corporate Access ID in their personal account profile (if you do not have it contact [richard.l.schneider@usace.army.mil](mailto:richard.l.schneider@usace.army.mil) or [judith.f.milton@usace.army.mil](mailto:judith.f.milton@usace.army.mil) for the number).
2. The Account/Login Information section is filled out by the person registering the project. It may be a Contractor or a USACE staff member.

##### **ELIGIBILITY SECTION**

Follow directions (accepting the terms and conditions)

Review your profile information and make corrections if needed

##### **RATING SYSTEM SELECTION SECTION**

Select single project registration and I know which rating system.

Select the rating system - currently only LEED-NC and LEED for Homes are approved for Army use without special approval.

LEED Minimum Program Requirements: select YES

### RATING SYSTEM RESULTS SECTION

Confirm selected rating system.

### PROJECT INFORMATION SECTION

**Project Title:** Begin the project title with a one-word identifier for the Installation. Do not include the word "Fort". After this match the project name used in P2 (contact the USACE Project Manager for this information) and identify the building being registered. Example: "Stewart 4<sup>th</sup> IBC - DFAC".

**Project Address 1 and 2:** This is the physical location of the project. Provide building number, street address, block number or whatever is known to best describe the location of the project on the Installation.

**Project City:** Installation Name

**State, Country, Zip Code:** Self-explanatory

**Anticipated Construction Start and End Dates:** Self-explanatory – give your best guess if unknown. Note that required data entry format is: 1 or 2 digit month/1 or 2 digit date/4 digit year (example 3/23/2010)

**Gross Square Footage:** Provide total area all buildings in LEED project. Exclude the area of any buildings that are exempt from the LEED achievement requirement (for example, exclude an unconditioned storage shed to be constructed with a barracks complex).

**Is Project Confidential:** Indicate NO except, if project has security sensitivity (elements that are FOUO or higher security), indicate YES.

**Notification of Local Chapter:** Indicate NO unless Government/USACE Project Manager requests you to indicate YES.

**Anticipated Project Type:** Select the most appropriate option from the drop-down menu.

**Anticipated Certification Level:** Select the applicable option from the drop-down menu (Silver is the usual level).

### PROJECT OWNER INFORMATION SECTION

**Project Owner First Name, Last Name, email, phone, address:** The Project Owner is the USACE Project Manager. Obtain this info from the USACE Project Manager.

**Organization:** U.S. Army Corps of Engineers. This field MUST be completed this way because it will be used as a search field by higher HQ to find all USACE registered projects. You may supplement it with district name at the end but DO NOT revise or use an acronym.

**May we publish Owner information:** Indicate NO

**Owner Type:** Pick Federal Government from drop-down menu.

**Project Owner Assertion:** Check the box

### PAYMENT INFORMATION

Self-explanatory

**APPENDIX Q**  
**REV 2.1 – 30 SEP 2010**  
**AREA COMPUTATIONS**

**Computation of Areas:** Compute the “gross area” and “net area” of facilities (excluding family housing) in accordance with the following subparagraphs:

**(1) Enclosed Spaces:** The “gross area” is the sum of all floor spaces with an average clear height  $\geq 6'-11"$  (as measured to the underside of the structural system) and having perimeter walls which are  $\geq 4'-11"$ . The area is calculated by measuring to the exterior dimensions of surfaces and walls.

**(2) Half-Scope Spaces:** Areas of the following spaces shall count as one-half scope when calculating “gross area”:

- Balconies
- Porches
- Covered exterior loading platforms or facilities
- **Covered but not enclosed spaces, canopies, training, and assembly areas**
- Covered but not enclosed passageways and walks
- Open stairways (both covered and uncovered)
- Covered ramps
- Interior corridors (Unaccompanied Enlisted Personnel Housing Only)

**(3) Excluded Spaces:** The following spaces shall be excluded from the “gross area” calculation:

- Crawl spaces
- Uncovered exterior loading platforms or facilities
- Exterior insulation applied to existing buildings
- Open courtyards
- Open paved terraces
- Uncovered ramps
- Uncovered stoops
- Utility tunnels and raceways
- Roof overhangs and soffits measuring less than 3'-0" from the exterior face of the building to the fascia

**(4) Net Floor Area:** Where required, “net area” is calculated by measuring the inside clear dimensions from the finish surfaces of walls. If required, overall “assignable net area” is determined by subtracting the following spaces from the “gross area”:

- Basements not suited as office, special mechanical, or storage space
- Elevator shafts and machinery space
- Exterior walls
- Interior partitions
- Mechanical equipment and water supply equipment space
- Permanent corridors and hallways
- Stairs and stair towers
- Janitor closets
- Electrical equipment space
- Electronic/communications equipment space

**Appendix R**

**RMS Submittal Register**

| RMS SUBMITTAL REGISTER INPUT FORM |                                    |   | CONTRACT NUMBER        |                    | DELIVERY ORDER    |              |                  |                   |                   |                        |                        |               |                          |                           |                          |                                  |                         |         |         |                      |                  |                      |                     |                         |                           |
|-----------------------------------|------------------------------------|---|------------------------|--------------------|-------------------|--------------|------------------|-------------------|-------------------|------------------------|------------------------|---------------|--------------------------|---------------------------|--------------------------|----------------------------------|-------------------------|---------|---------|----------------------|------------------|----------------------|---------------------|-------------------------|---------------------------|
| TITLE AND LOCATION                |                                    |   |                        |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          |                                  |                         |         |         |                      |                  |                      |                     |                         |                           |
| Button                            | <-----Right click for Instructions |   | TYPE OF SUBMITTAL      |                    |                   |              |                  |                   |                   |                        | CLASSIFICATION         |               |                          |                           |                          | REVIEWING OFFICE                 |                         |         |         |                      |                  |                      |                     |                         |                           |
| SECTION                           | PARAGRAPH NUMBER                   | DESCRIPTION OF ITEM SUBMITTED                                 | 01 - PRECON SUBMITTALS | 02 - SHOP DRAWINGS | 03 - PRODUCT DATA | 04 - SAMPLES | 05 - DESIGN DATA | 06 - TEST REPORTS | 07 - CERTIFICATES | 08 - MFRS INSTRUCTIONS | 09 - MFRS FIELD REPORT | 10 - O&M DATA | 11 - CLOSEOUT SUBMITTALS | FO - FOR INFORMATION ONLY | GA - GOVERNMENT APPROVED | DA - DESIGNER OF RECORD APPROVAL | CR - CONFORMANCE REVIEW | DA / CR | DA / GA | DO - DISTRICT OFFICE | AO - AREA OFFICE | RO - RESIDENT OFFICE | PO - PROJECT OFFICE | DR - DESIGNER OF RECORD | AE - ARCHITECT / ENGINEER |
| 00 72 00                          | 52.236-13                          | Accident Prevention Plan                                      | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 00 73 00                          | 1.11                               | Dev. From Accept. Design. No Deviation from Contract          |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          |                                  | X                       |         |         | X                    |                  |                      |                     | X                       |                           |
| 00 73 00                          | 1.11                               | Dev. From Accepted Design - Deviates from Contract            |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          |                                  |                         | X       |         | X                    |                  |                      |                     | X                       |                           |
| 00 73 00                          | 1.17                               | Supplemental Price Breakdown                                  | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 00 73 00                          | 1.18                               | SSHO Qualifications   | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 10 00                          | 5.2.3.1                            | (if concrete pavement) Joint Layout Plan with design drawings |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         |                      |                  |                      |                     |                         |                           |
| 01 10 00                          | 5.5.2                              | Building Envelope Sealing Performance Testing                 |                        |                    |                   |              |                  | X                 |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 10 10                          | ***                                | Tests as Req by Codes - DOR Develops Test Program             |                        |                    |                   |              |                  | X                 |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 5.8.3                              | BAS Review Information  |                        | X                  |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          |                                  | X                       |         | X       | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 5.8.3                              | BAS Performance Verification Test                             |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 5.8.4                              | Testing Adjusting and Balancing                               |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 5.8.5                              | Commissioning   |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 6.15                               | Environmental As Required for Site Specific                   |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 6.16                               | Permits as required for Site specific                         |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 10 00                          | 5.10.2                             | Fire Protection Tests   |                        |                    |                   |              |                  | X                 | X                 |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 32 01.00 1C                    | 3.4.1                              | Preliminary Project Schedule                                  | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 32 01.00 1C                    | 3.4.2                              | Initial Project Schedule                                      | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 32 01.00 1C                    | 3.4.3                              | Design Package Schedule                                       | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 32 01.00 1C                    | 3.6.1                              | Periodic schedule updates from the Contractor                 | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 32 01.00 1C                    | 3.7                                | Time Extension Request (Schedule)                             | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 00                          | 1.8                                | Submittal Register - DOR Input Required                       | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 33 00                          | 1.8                                | Submittal Register Updates (Design Packages, etc.)            | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 33 00                          | 1.3.1                              | Substitution of Manuf or Model Named in Proposal              |                        | X                  | X                 |              |                  |                   |                   |                        |                        |               |                          |                           |                          |                                  | X                       |         |         | X                    |                  |                      |                     | X                       |                           |
| 01 33 16                          | 1.2                                | Identify Designer(s) of Record                                | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 1.1.2 / 3.2.4                      | Fast Track Design Package(s)                                  |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 1.2                                | Identification of all Designers of Record                     | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.2.1                              | Site and Utility Design Package, incl. Substantiation         |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.2.2/3.5                          | Interim Design Submittal Package(s), incl. Substantiation     |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.1                              | Drawings  |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.2                            | Sitework Design Analyses                                      |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.3                            | Structural Design Analyses                                    |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.4                            | Security Design Analyses                                      |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.5                            | Architectural Design Analyses                                 |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.6                            | Mechanical Design Analyses                                    |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.7                            | Life Safety Design Analyses                                   |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.8                            | Plumbing Design Analyses                                      |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.9                            | Elevator Design Analyses (as Applicable)                      |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.10                           | Electrical Design Analyses                                    |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.11                           | Telecommunications Design Analyses                            |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.2.12                           | Cathodic Protection Design Analyses                           |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.3                              | Geotechnical Investigations and Reports                       |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.4                              | LEED Submittals   |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.5                              | Energy Conservation Documentation                             |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.6                              | Specifications  |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.5.7                              | Building Rendering  |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.2.4/3.7                          | Final Design Submittal Package(s), incl. Substantiation       |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.7.5                              | DD Form 1354 (Transfer of Real Property)                      |                        |                    |                   |              |                  |                   |                   |                        |                        | X             |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.2.5/3.8                          | Design Complete Submittal Package(s)                          |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | 3.3.3                              | Design and Code Review Checklists                             |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | A-2.0                              | SID - Interim and Final (as applicable)                       |                        |                    | X                 | X            | X                |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 33 16                          | B-2.0                              | FFE (as Applicable)   |                        |                    |                   |              | X                |                   |                   |                        |                        |               |                          |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 45 04.00 1C                    | 3.2                                | Design and Construction QC Plan                               | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 57 20.00 10                    | 1.2                                | Environmental Protection Plan                                 | X                      |                    |                   |              |                  |                   |                   |                        |                        |               |                          |                           |                          | X                                |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.2.1                              | Final as-Built Drawings                                       |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.2.7                              | Provide final as-built CADD and BIM Model files               |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.2.9                              | Provide scans of all other docs in Adobe.pdf format           |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.3.1                              | Equip-in-Place list of all installed equip and cost           |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.3.2                              | Data on equip not addressed in O&M manuals                    |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.3.3                              | Final as-built specs - electronic files                       |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.4.2.1                            | Warranty management plan - FAR 52.246-21                      |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.4.2.1                            | Certificates of Warranty for extended warranty items          |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.4.2.1                            | Contractor's POCs for implementing warranty process           |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.4.2.1                            | List of each warranted equip, item, feature or system         |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.5                                | See also Section 01 10 00 par. 5.8.4 and 5.8.5                |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 10                    | 1.6.1.2                            | Equipment O&M Manuals - 1 electronic / 2 hard copies          |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 10                    | 1.7                                | Field Training DVD Videos                                     |                        |                    |                   |              |                  |                   |                   |                        | X                      |               |                          | X                         |                          |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 10                    | 1.8                                | Pricing of CF/CI and GF/CI Property                           |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           | X                        |                                  |                         |         |         | X                    |                  |                      |                     |                         |                           |
| 01 78 02.00 1C                    | 1.11                               | List of Completed Cleanup Items                               |                        |                    |                   |              |                  |                   |                   |                        |                        |               | X                        |                           |                          |                                  | X                       |         |         | X                    |                  |                      |                     |                         |                           |

**Appendix AA**  
**American Water Enterprises**

## **Water & Wastewater System Improvements within Design-Build Project footprint**

### **DRAFT FOR DISCUSSION:**

Presented herein is a proposed procedure for planning, design, construction, inspection and acceptance of improvements to the water and wastewater utilities at Fort Sill in cooperation with Design Contractors (DC) and the other BRAC related construction project contractors and American Water Enterprises (AWE) within the designated project limits. For the purposes of this discussion paper, the DC projects could also include projects within the soon to be privatized housing areas.

(It is understood that this document outlines an agreed upon procedure that will need to be reviewed by the contracting staff for the AWE UP contract and the COE's contracting staff for the DC)

### **Overview:**

This procedure is to be used when improvements to the water and wastewater utility system are inside project limits of Design-Build contracts managed by the Army at Fort Sill. This could also include housing privatization and the projects related to the BRAC construction. The Army intends to embark on numerous projects via Design Build and Design Bid Build projects at Fort Sill beginning in 2006. Also on the horizon is housing privatization. When housing privatization and the projects related to the BRAC related construction projects occur it is imperative to have significant cooperation between AWE and DC with respect to the water and wastewater utility system improvements planned to be designed and built by DC. It is also imperative to have all improvements to the water and wastewater systems designed and constructed according to AWE standards and specifications and to be done in coordination with the long-term water and wastewater system improvement plans of AWE. AWE must be involved in the design, coordination, and planning of such utility improvements because these changes can have larger implications to the overall performance of the system – the level of this impact to the system, base wide, can only be evaluated by AWE. It is also important to note that AWE is the owner and the permit holder for each of the water and wastewater utility systems at Fort Sill.

It is understood that the BRAC and RCI related projects will occur in several phases as will the related utility improvements for each of those phases.

The following procedure should be followed for water and wastewater utility improvements by the DC. This procedure is specific to the BRAC, DC, and Housing Privatization related construction projects and does not apply to other parts of the water and wastewater system at Fort Sill outside of the project areas. Water and wastewater systems improvements outside the project perimeter limits but necessary to service these projects will be designed built and constructed by AWE under normal contract modification practices.

The following steps are to be included in the process:

1. Planning - Conceptual and Schedule (Govt. w/AWE Participation)
2. Design Review –60%, and final (Govt. and AWE; AWE to provide cost for review).
3. Construction Permitting (ODEQ)
4. Quality Assurance(COE evaluations with supplement inspection by AWE)
5. Review, Acceptance and Transfer of Utility System Improvements



6. Warranty of Utility System Improvements by Contractor thru COE to AWE
7. Payment for services will be made by the Government – limited to acceptable industry market rates

### **Conceptual Planning**

- AWE will take part in Army planning charrettes.
- At end of conceptual planning phase, AWE will provide over site and review costs.

### **Design and Design Review:**

Subsequent to the Conceptual Planning Stage, the DC can proceed with the development of design drawings and specifications for the water and wastewater improvements when needed to support the project. These design plans must be reviewed and concurred by AWE.

- The DC shall submit 5 copies to AWE of the 60% design plans and specifications of the proposed improvements to the utility system.
- AWE will provide written comments to the DC representatives within 14 days of receipt of the plans. In some circumstances additional hydraulic modeling work may be required after these initial comments and recommendations in order to provide comments. In these circumstances, AWE will provide the DC and Government with the estimated schedule and cost to complete the additional modeling work.
- The DC shall submit 5 copies to AWE of the final design plans and specifications. Complete Final design drawings shall be sealed by an Oklahoma Professional Engineer. The DC will complete the Oklahoma Department of Environment Quality (ODEQ) permit application and submit to AWE for review.
- When the plans have been approved by AWE, they will be marked "Approved by AWE" and the DC will be notified in writing of such approval. The AWE approved plans will be used for application of construction permit with ODEQ. (Typically AWE requires 14 days and ODEQ could take up to 30 days for final design review for permitting.)
- AWE will review, sign and return the permit application to DC for submission to ODEQ within five (5) business days. DC will be responsible for any permit application fees to ODEQ.

### **Construction Permitting:**

When the plans have been approved by ODEQ they will be marked "Approved by ODEQ" and the DC will be notified in writing of such approval. The ODEQ approved plans will be used for construction and as the basis for creating the as-built drawings.

Oklahoma Department of Environment Quality (ODEQ) has primacy for regulation of the water and wastewater system at Fort Sill. Proposed improvements to the water and wastewater system must be approved and officially permitted by ODEQ for the construction of utility improvements.

- Once the plans are approved by the ODEQ, the ~~DC~~ Construction Company (CC) working with the DC shall be responsible for all labor, equipment, and material to install the utility system improvements, using the ODEQ and AWE approved plans and specifications.

**Construction Review:**

- The COE will provide a Construction Quality Assurance (QA) Inspector for all water and wastewater construction. The CC will be required to provide a Quality Control (QC) Representative approved by the COE to oversee the construction.
- An AWE representative will provide periodic observation of construction work to provide Quality Assurance for the work. Should during the course of observing or reviewing construction work, the AWE representative discovers an unacceptable installation, the AWE representative will contact the COE inspector, who shall have the authority to cause the CC working with the DC to take corrective action to meet the ODEQ and AWE approved drawings and specifications. The COE will have available copies of all testing reports, daily reports, and work logs developed by the COEs QA at the Resident Office for AWE to review upon request. During the course of construction of AWE Facilities weekly meetings are to be held by COE with all concerned parties in attendance.

**Review, Acceptance and Transfer of Utility System Improvements:**

- Upon completion of the utility system phase improvements, the ~~DC~~ CC working with the DC shall supply Army Corps of Engineers (COE) and AWE with as built drawings in an electronic format in accordance with the project requirements, and a detailed accounting of the value of the utility system improvements. If the work is completed in phases, separate DD Form 1354s with the corresponding acceptable dates will be issued to AWE from the Government. It is understood that the guarantee/assurance that the materials and workmanship and good utility practice meet AWE requirements is provided thru the approved specific requirements (plans and specifications) and by the in process construction inspections performed by AWE, CCs QC, and the COEs QA.

It is understood that the completed newly constructed facilities will be transferred to AWE by the Government at completion of construction using a DD Form 1354 which will itemize the facility being transferred to AWE to include the cost of the facility and any pending punch list items.

- Within 14 days of receipt of the as built drawings from the DC or CC, AWE will provide a letter of acceptance of the as built drawings.
- Fort Sill, working with AWE will provide a contract modification to update the utility system inventory for the existing AWE Maintenance Contract.

**Warranty of Utility Improvements:**

COE to review requirements for bonding, warranty requirements, surety bond etc. The Contractors will have a bond with the COE to cover the construction of the facility plus validated construction deficiencies or problems with the system. The warranty will be in effect for a period of one year starting at the completion of the construction and acceptance by the Government.

Normal maintenance such as greasing of valves, etc, if required, will be the responsibility of AWE during this warranty period.

It is noted that during the warranty period, AWE owns the water and sewer systems per the Contract Modification. Thus, AWE would be responsible for providing adequate service and environmental permit compliance.

In the event warranty repairs are required, AWE shall notify its designated Contracting Officer in writing, documenting the deficiency. The Contracting Officer shall work with Ft Sill and the COE to substantiate the defective work claim and cause the work to be corrected to AWE standards and specifications by the Contractors. In the event the repairs must be made immediately to maintain adequate environmental compliance, safety of life or property, and/or service, AWE has the right, to undertake corrective action immediately, and notify the Contracting Officer or their designated representative as soon as possible, but no later than noon of the next business day. AWE will track all costs associated with the repairs including overhead and profit and submit the same to the Contracting Officer to seek reimbursement from Ft Sill. Ft Sill will pay AWE, and seek reimbursement from the Contractors directly.

**Payment for AWE's Services:**

- Government shall be responsible for all costs incurred by AWE including engineering, construction review; legal, overhead, administrative and other costs incurred by AWE in connection with the utility system improvements related to the housing privatization efforts and other BRAC related construction projects at Fort Sill.
- AWE's resident engineering and inspection services will normally be performed by AWE Utility Engineer. For those activities or periods that are in excess of the workload of the AWE Utility Engineer, the Government shall be responsible for the additional cost of AWE's resident engineering and inspection services required during construction and testing of the utility system improvements.
- All bills submitted by AWE to the Government for costs incurred by AWE in relation to this work shall be due and payable upon presentation to the Contracting Officer.

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**01001 SCOPE OF WORK UNDER THIS CONTRACT**

- .01 The work to be done under this Contract includes the supply of materials, labor, equipment, permits, etc. necessary for the complete construction of the works shown on the Contract Drawings and as specified herein, and a guarantee of all workmanship and materials for a period specified herein.
- .02 Refer to Special Provisions for the complete description of the work to be carried out for this contract.

**01002 INCLUSIONS**

- .01 The following sections are included and form part of Division 1:
  - 01000 General and Requirements
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- .02 A separate field office will be required for the Engineer on this project.



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**SECTION 01200**

**GENERAL INSTRUCTIONS**

**01200 GENERAL INSTRUCTIONS**

- .01 The Contractor shall be responsible for the layout elevations, alignment of the work and shall verify all measurements and details of the existing equipment and structures necessary for the proper fitting and connection of the new work to it, before proceeding with the work. Any discrepancies between the drawings and the existing work shall be referred to the AW Project Manager. The Contractor is responsible for the proper fitting of the work and shall make such changes as necessary and directed by the AW Project Manager without additional cost to AW.
- .02 The Contractor shall restrict all operations to within the limits of the easements and properties as shown on the drawings and staked in the field.
- .03 The AW Project Manager at his discretion, may approve minor changes in the route or location of new watermain during construction. However, any such change in location shall not be considered as a basis for a claim for extra compensation, regardless of the reason for changing the location.
- .04 Any work done during the winter months shall be carried to completion as quickly as possible. The Contractor shall supply all necessary heating, fuel, equipment and materials required to adequately protect the work from frost damage during and after laying or placing, all to the AW Project Manager's satisfaction.

**01221 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS**

- .01 Dimensions on drawings when witnessed by lines and arrow points, shall take precedence over measurements by scale.
- .02 Larger scale drawings shall take precedence over those of smaller scale. Supplementary drawings and specifications supersede previous drawings and specifications.
- .03 Words, phrases and abbreviations that have a well-known technical or trade meaning shall have that meaning in these specifications and drawings.
- .04 In case of discrepancy between the drawings and specifications, figure dimension on the drawings shall govern, except where the dimension depends on the dimension of a specified product in which case the dimensions of the product shall govern. In the case of discrepancy in description of materials and methods, the specifications shall govern.

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- .05 All cases of discrepancy shall be referred to the AW Project Manager who shall give his decision in writing. The decision shall be consistent with the evident meaning and intention of the drawings and specifications and the above paragraphs.
- .06 The location of undimensioned fixtures, outlets, conduits, piping, etc., is shown approximate. Actual location shall be made to suit job conditions as approved by AW Project Manager.
- .07 The drawings and specifications are complementary and what is called for by either shall be as binding as if called for by both. It is the intention to provide for a finished piece of work complete in all essentials, including all items reasonably inferable from all of the Contract Documents, notwithstanding that every item necessarily involved may not be particularly mentioned. The Contractor shall not take advantage to the detriment of the AW's interest, of any manifestly unintentional errors or omissions should such exist. Where the quality of workmanship or materials is not specifically stated, the best quality shall be provided.

**01222 REGULATING REQUIREMENTS**

- .01 Construction methods, equipment and all operations shall conform with the applicable regulations and amendments made under the applicable State Labor Act, Construction Safety Act, and any or all other Acts and By-laws in force to ensure the safety of the works and the Contractor's workmen and others at all times.
- .02 The Contractor shall apply for, obtain and pay for all approvals and permits required for this project and will produce evidence of payment of the same to the AW Project Manager.
- .03 AW will provide a clean set of Contract Drawings and Specifications for each application.
- .04 The Contractor shall arrange for all regular inspections by authorities having jurisdiction and all final inspections required.

**01223 NOTIFICATION OF INTERESTED PARTIES**

- .01 The Contractor shall be responsible for adequately protecting any public or private service or utility adjacent to the work.
- .02 The Contractor's attention is drawn to particular requirements of the Specifications with respect to prior arrangements with and notifications to various parties before commencing work at specific locations.
- .03 Prior to commencing construction adjacent to existing sewers, watermain pipes, gas pipes, communication lines, telephone lines or hydro cables, conduits, poles, street signs, etc., or obtaining stakeout of underground services or utilities, the Contractor shall notify the party concerned at least two full working days before commencing work in the vicinity.

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**01224 SITE ADMINISTRATION**

- .01 At all times during the course of the work, the Contractor shall provide suitable and adequate toilet facilities for all persons employed on the work, subject to approval of type, size, and location by the local authorities. The facilities shall be maintained in proper sanitary conditions, frequently disinfected and, if directed by the AW Project Manager, shall be removed from the work. Any contaminated soil and material shall be removed and replaced with fresh, clean material and the site left in a clean, sanitary condition.
- .02 The Contractor shall provide and maintain on the site in a clean orderly condition, completely equipped first aid facilities which shall be readily accessible at all times to all his employees. The Contractor shall designate certain employees who are properly instructed to be in charge of first aid. At least one such employee shall always be available on the site while work is being carried on. A telephone call list for summoning aid, such as doctors, ambulances, pulmotors, and rescue squads from outside sources shall be conspicuously posted.

**01225 CO-ORDINATION OF THE WORK**

- .01 The Contractor shall be responsible for the co-ordination of the work of all trades to the end that the combined work shall produce a first class result, without delays.
- .02 The Contractor shall expedite the ordering and delivery of all materials and equipment required. No claims will be allowed for delays or additional expenses resulting from failure to place orders in ample time.
- .03 The Contractor shall arrange for regular inspections and a final inspection with the inspector.
- .04 The Contractor shall provide notice to the applicable State – ‘Construction Safety Branch’ office with the appropriate ‘notice of construction information’ as required, prior to commencing work.

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GENERAL INSTRUCTIONS

**01226 PROJECT MEETINGS**

- .01 A pre-construction meeting will be arranged by the Engineer immediately upon award of the Contract. A senior Contractor representative and the designated superintendent shall attend.
- .02 The Contractor shall attend job progress meetings as required by the AW Project Manager. These meetings shall be held once a month or more frequently should the AW Project Manager deem necessary. The meetings will be held at the Contractor's site office to discuss the progress of the work. Sub-contractors, suppliers, and others shall be in attendance as requested.

**01227 SITE SIGNS AND NOTICES**

- .01 AW will provide project sign free of charge to the Contractor.
- .02 Contractor shall pick up, erect and return signs to and from the designated supplier.

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SCHEDULES

**SECTION 01250**

**SCHEDULES**

**01250 SCHEDULES**

- .01 Four (4) copies of the Construction Schedules showing the dates for the commencement and the completion of major components of the works shall be prepared by the Contractor and submitted to the Engineer within two (2) weeks after the signing of the Contract.
- .02 The schedule shall show in a clear network diagram the proposed progress of all activities for the main items, site developments, structures and sub-trades of the Contract and shall indicate where applicable, the labor, construction crews, plant and equipment to be pieces of equipment to be supplied shall be shown. The schedule shall be predicated on the completion of all the work on or before the date of completion as per contract agreement.
- .03 Provide a three (3) week rolling window schedule indicating activities completed during the previous week and those planned for the next two (2) week period. Submission shall be provided to the AW Project Manager no later than 1:00 p.m. of each Friday.
- .04 The construction sequence shall be in conformance with the requirements of the project and shall be subject to the approval of the AW Project Manager.
- .05 The Contractor shall, at the request of the AW Project Manager supply written evidence, either in the form of a schedule or letter, showing his proposed delivery. The AW Project Manager also reserves the right to request unpriced purchase orders showing with whom the Contractor has placed his orders or contracts, as the case may be.
- .06 If, during the course of the work, the time of completion of the Contract is extended, the Construction Schedule shall be corrected to show the revised commencement and completion dates of those parts of the work which are affected. In any event, the schedule shall be revised when directed by the AW Project Manager and the Contractor shall have no claim for extra payment by reason of additional work resulting from such an order.
- .07 The review of the Contractors schedule or construction program does not relieve the Contractor of any of his duties and responsibilities under this Contract.
- .08 The Contractor shall submit details of proposed site layout for approval prior to mobilizing on site.

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**01251 SEQUENCE OF CONSTRUCTION**

- .01 The contractor shall submit a written sequence of construction to the AW Project Manager for Approval, and will be fully responsible for ensuring that sewage pumping is provided continuously during the course of construction. The following is a suggested “sequence of construction”:
- .02 THE CONTRACTOR WILL NOT BE PERMITTED TO DECOMMISSION AND DEMOLISH ANY PORTION OF THE EXISTING WATER DISTRIBUTION OR WASTEWATER COLLECTION SYSTEM, UNTIL THE NEW FACILITIES ARE FULLY OPERATIONAL.
- .03 All operation of the existing water valves will be conducted by the AW’s operations staff. Provide a minimum of 72 hours written notice to co-ordinate the construction works with AW’s operations staff.

**01252 OVERTIME**

- .01 The AW Project Manager may order the work to proceed on a two or three eight-hour shift basis if he deems this necessary to speed up the work, or he may order any work to be carried out in whole or in part at night, and the Contractor shall have no claim for extra compensation in respect thereof. No work, however, shall be undertaken at night without the consent in writing of the AW Project Manager.
- .02 Whenever, in the judgement of the AW Project Manager, it may be necessary or expedient, in order to preserve and maintain traffic over or on any street or road, to do work at night or after or before the regular time of ending or beginning labor, such night or overtime work shall be performed by the Contractor without additional or extra cost to the Owner beyond the price bid for the work.
- .03 No Saturday or Sunday work will be permitted, except in the case of emergency, and then only with the written permission of the AW Project Manager and to such extent as he may judge to be necessary.
- .04 The Contractor shall, as far as possible, refrain from work on days which are legal holidays recognized by AW. In case he desires to work on any such holiday he shall notify the Engineer in writing at least five (5) days in advance of such holiday that he desires to work, stating these places where said work will be conducted. If the Contractor fails to give such notice in advance of any holiday, such failure shall be considered as an indication that no work requiring the presence of an AW Project Manager or Inspector is to be done by the Contractor on such a holiday.



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SUBMITTALS

**SECTION 01300**

**SUBMITTALS**

**01300 SUBMITTALS**

- .01 All submittals generally described below shall be made to the AW Project Manager adequately identified by including a reference to the specification item number or drawing number of which it is made.

**01310 SHOP DRAWINGS**

- .01 For the portion of the work where detailed drawings are to be supplied by the Contractor, six (6) copies of same with specifications, shall be submitted to the AW Project Manager for review. Two (2) copies will be retained by the AW Project Manager.
- .02 When submitting shop drawings, the Contractor shall notify the AW Project Manager in writing of all respects in which such drawings differ from the requirements of the Contract.
- .03 The Contractor or his sub-contractor shall check and initial all shop drawings before submission in order to intercept any errors or omissions.
- .04 Work shall not start until all shop drawings related to the said work have been reviewed by the AW Project Manager. All drawings in use on the job site shall bear the completed AW Project Manager reviewed stamp. Any work done without the AW Project Manager's reviewing such shop drawings shall be solely at the risk of the Contractor.
- .05 Review of the Contractor's drawings by the AW Project Manager shall not relieve the Contractor of the correctness thereof, nor from the results arising from any error or omission of details of design. Acceptance of drawings and specifications shall be subject to final approval of the equipment and materials after they have been put in commission, all guarantees have been fulfilled and the general operation of the equipment and materials have been found satisfactory to the AW Project Manager.
- .06 Shop Drawings, Manufacturer's Cut Sheets (i.e., Brochure Data Sheets), and Manufacturer's Certifications are to be submitted for the following:

**Watermains:**

- Watermain Pipe Materials: (ductile iron, steel pipe, copper, polyethylene, polyvinyl chloride, prestressed concrete cylinder pipe)
- Watermain Fittings: (bends, tees, couplings, Restrained Joint Glands, etc.)
- Valves: (gate valves, butterfly valves, valve boxes, air release and vacuum relief valves, pressure reducing valves)

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- Water Service Connections: (service pipe materials, tapping saddles, corporation stop, curb stop and box)
- Fire Hydrants
- Water Meters

**Wastewater Sewers:**

- Wastewater Pipe Materials: (polyethylene, polyvinyl chloride, prestressed concrete cylinder pipe)
- Manholes: (precast concrete, fibreglass)
- Manhole Frames and Covers:
- Manhole Height Adjustments: (bricks, precast modulock rings)
- Valves: (gate valves, air release and vacuum relief valves)

**General Shop Drawing Information:**

- Listing of Aggregate Suppliers
- Concrete Mix Design Data and name of Supplier
- Asphalt Mix Design Data and name of Supplier
- Cement Stabilized Sand Mix design and name of Supplier
- Mortar Mix Design
- Brick Supplier

**Special Construction:**

- Dewatering Methods
- Vertical Trench Construction
- Tunnel Construction

**Site Restoration Items:**

- Location of Waste Disposal Site and Letter of Clearance from Owner.
- Geotextile
- Topsoil
- Hydromulch Seeding Mix Design and name of Supplier
- Sodding

**01311 WORKING DRAWINGS**

- .01 No change to the working drawings and specifications (Shop Drawings) are to be made after they have been accepted by the AW Project Manager.
- .02 In the event of alterations or changes being authorized by the AW Project Manager, submit six (6) copies of each of the revised drawings and specifications indicating the changes to the AW Project Manager for review. Four (4) sets will be returned to the Contractor.

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**01315 SAMPLES**

- .01 Samples of materials and workmanship shall be provided as required by the AW Project Manager. The Contractor shall bear the expense of providing samples and proper storage as required.
- .02 No material used in the work shall be inferior in any way to the material approved.
- .03 Approval notwithstanding, the AW Project Manager may reject materials delivered to the site and subsequently found to be unsuitable or unsound.

**01325 MAINTENANCE PROGRAMS**

- .01 Before the Contractor leaves the site, he is required to submit a letter setting out the arrangement he has made for the carrying out of maintenance work up to the end of the period of guaranteed maintenance. This letter shall give a telephone number and address for the receipt of notices relating to maintenance. Unless the Contractor's headquarters are close to the site of the works, he shall be required to make satisfactory arrangements with a local contractor for attending to surface maintenance work, or with the AW site operations staff for the same to be carried out at his cost.
- .02 A copy of the Contractor's purchase order on such arrangement shall be provided for the AW Project Manager. Failure of the Contractor to make such arrangements and submit a copy of his purchase order for same to the AW Project Manager may delay processing of the Completion Certificate and accompanying payments. Moreover, in the case of the Contractor's failure to arrange in a satisfactory manner for maintenance work to be carried out, the AW Project Manager shall arrange for it to be done by others at the Contractors cost and expense.
- .03 For maintenance work during construction, reference is to be made to the relevant provisions herein and hereinafter on clearing and cleaning up and reinstatement of work.
- .04 All newly constructed work shall be carefully protected from damages. No wheeling or walking or placing of heavy loads on it shall be allowed and any portion damaged shall be replaced by the Contractor at his own expense.
- .05 Further, the Contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the Owner.
- .06 All structures shall be protected in a manner satisfactory to the AW Project Manager. Should any parts of the structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor

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at his own expense and to the satisfaction of the AW Project Manager. If, in the final inspection of the work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the labor and materials required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein for at least the guarantee period described in the General Conditions of this Contract.

**01330 "AS-BUILT" DRAWINGS**

- .01 The Contractor shall furnish to the AW Project Manager two (2) sets of prints of the as-built drawings. (i.e., one (1) full size set, and one (1) reduced size set 11x17")

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TEMPORARY FACILITIES

**SECTION 01500**

**TEMPORARY FACILITIES**

**01510 TEMPORARY FACILITIES**

- .01 Provide all temporary facilities as specified in the General Conditions except as amended or extended by other items of this section.
- .02 Arrange for necessary permits for temporary utilities, and bear all charges levied for these utilities.

**01510 FIELD OFFICES AND SHEDS**

- .01 The Contractor shall provide and maintain such substantially constructed, weathertight structures as will adequately house and service personnel of the Contractor working on or associated with this project. In addition, he shall furnish and maintain satisfactory weathertight structures with raised floors as may be required to adequately protect those materials stored on the site which might be damaged by the weather.
- .02 The locations of the proposed temporary buildings used for construction purposes and the type of buildings to be used shall be acceptable to the AW Project Manager before erection work commences.
- .03 Temporary buildings must be kept clean and free from nuisance so as not to become a danger to the adjoining properties or to form grounds for complaints from property owners adjacent to the site.
- .04 Further, the Contractor shall furnish and maintain all apparatus and equipment, such as ladders, scaffolds, ramps, runways, temporary stairs, derricks, hoists, elevators, chutes, etc., as required for the proper execution and progress of the work. Such facilities shall be strong and substantial and safe for the purpose for which they are intended, and shall meet all applicable requirements of governing regulations and authorities.
- .05 When temporary building facilities are no longer needed in construction, they shall be promptly dismantled, unless otherwise specified or directed, and removed from the site.
- .06 The lump sum stated in the Schedule of Quantities and Prices under General shall include full compensation for providing field offices as specified. The cost of long distance calls made by the AW Project Manager shall be reimbursed to the Contractor.

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**01515 TEMPORARY UTILITIES**

- .01 All equipment to be operated according to the applicable Labor, Health and Safety Acts.
- .02 The Contractor shall provide for the supply of water, electrical power, gas, sanitary facilities, heat and any other temporary services required during construction. He shall be responsible for all fees, permits and charges incurred throughout the construction period.

**01535 ROADS**

- .01 The Contractor shall so conduct his operations on the site of these works that the use of adjacent roads by vehicles employed under this Contract will not endanger public pedestrian and vehicular traffic thereon nor hinder the use thereof.
- .02 The Contractor shall clean and maintain the cleanliness of adjacent roads and the property occupied by him from waste material or refuse resulting from his operation to the satisfaction of the AW Project Manager.
- .03 Trucks hauling excavated material, cement, sand, stone or other loose material to or from the site shall have their loads trimmed and their bodies shall be tight in order that no spillage of their loads will occur.
- .04 In general, the Contractor's truck and equipment operations on all roads shall be governed by the Highway Traffic Act, local traffic ordinances and regulations of the local Fire, Police, and local Municipality Works Department.
- .05 Should the Contractor, in the opinion of the AW Project Manager, be negligent in his duties in maintaining proper street cleanliness, the AW Project Manager will take the necessary steps to perform such cleaning and will charge the Contractor all costs therefore.

**01545 PROPERTY PROTECTION**

- .01 Trees, fences, poles, and all other property shall be protected unless their removal is authorized. Any property damage shall be satisfactorily restored by the Contractor.

**01546 GUARD RAILS, BARRICADES AND SCAFFOLDING**

- .01 Provide secure, rigid guard railings and barricades around deep excavations, open shafts, open stairwells, open edges of floors and roofs, and to separated construction work from plant operations when in close proximity. Provide lighting as required for safety.
- .02 Provide and maintain scaffolding and ramps.



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ENVIRONMENTAL CONTROLS

**SECTION 01550**

**ENVIRONMENTAL CONTROLS**

**01550 ENVIRONMENTAL CONTROLS**

- .01 It is intended that the works proposed be executed in such a manner which, to the fullest possible extent, minimizes any adverse effects on the cultural and natural environment of the project area. The environmental Conditions of Contract stated herein must be complied with in all respects. It is a responsibility of the Contractor that all his personnel be sufficiently instructed so that the work is carried out in a manner consistent with minimizing environmental insult. Contractors are informed that AW may assign full or part-time on-site inspectors whose sole responsibility is to ensure environmental compliance objectives.
- .02 Should the Contractor wish to obtain access to the easements by way of other than public streets, or access routes already set out, he shall obtain written permission in a form to be approved by the Engineer, from the property owners involved and shall furnish the Engineer with a copy of such permission. The Contractor shall indemnify and save harmless AW, it's officers and agents from all claims and shall assume all liabilities arising from such permission. All access roads shall be constructed by the Contractor only at locations approved by the AW Project Manager. The cost of additional access shall be the responsibility of the contractor and shall not be considered as extra to the AW.
- .03 The Contractor shall exercise extreme care when refuelling machinery. Refuelling and maintenance of equipment shall not be undertaken in or adjacent to watercourses. Suitable fuelling and maintenance areas shall be established and all maintenance and fuelling conducted in these areas. No fuelling of backhoes shall be carried out within 100 feet of any watercourse.
- .04 In general, the entire site shall be restored to a state equal or if specified elsewhere to a condition better than existing conditions.
- .05 Restoration shall be initiated as soon as backfilling and compaction activities have been completed.
- .06 Temporary roads shall be removed as soon as construction activities can permit and the vegetative cover shall be restored to its original condition by replanting of natural cover all as specified herein or indicated on the drawings.
- .07 All vehicles and equipment shall be equipped with efficient muffling devices to minimize noise levels in the project area.
- .08 The Contractor shall establish and maintain site procedures consistent with the objective that noise from the construction area be minimized and in accordance with local by laws.

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- .09 In areas where some permanent installations, such as tunnel shafts, are required, other devices such as artificial barriers, berms, etc. shall be used to minimize noise levels.
- .10 The Contractor shall take such steps as may be required to prevent dust and mud nuisances resulting from the construction site. Dust control measures shall be carried out at all locations on site or on adjacent roads.
- .11 Permitted dust control measures include applications of calcium chloride or water. In general, the use of calcium chloride shall be minimized, particularly in close proximity to watercourses and the use of more frequent water application is encouraged. No chemical means of dust control shall be initiated without prior approval by the Engineer.
- .12 The transporting of excessively dusty materials such as cement must be carried out in covered haulage vehicles.
- .13 The Contractor shall be responsible for the protection of tops, trunks and roots of existing trees on the project site that are to remain. Existing trees subject to construction damage shall be fenced before any work is started. Wherever possible, do not permit heavy equipment or stockpiles within branch spread. Remove interfering branches without injury to trunks and cover scars immediately with tree paint such as Tree Wound Dressing.
- .14 Where excavating, filling or grading is required within the branch spread of trees that are to remain the work shall be performed as follows:

Trenching - When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunnelled under or around the roots by careful hand digging and without injury to the roots. Any roots over one (1) inch which are damaged, shall be treated immediately with tree paint.

Raising Grades - When the existing grade at tree is below the new finished grade, and fill not exceeding 15 inches is required, clean washed gravel graded from one (1) inch to two (2) inch size shall be placed directly around the tree trunk. The gravel shall extend out from the trunk on all sides to a minimum of 20 inches and finish approximately two (2) inches above the finished grade at tree. Install gravel before earth fill is placed. New earth fill shall not be left in contact with the trunks of trees requiring fill.

Lowering Grades - Trees marked for preservation that are located above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Exposed or broken roots shall be cut clean and covered with topsoil.

- .15 Trees potentially undermined by trench construction shall be braced by approved means, for the period of open trench operations.

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**SECTION 01600**

**MATERIALS AND EQUIPMENT**

**01600 MATERIALS AND EQUIPMENT**

- .01 All equipment installed and materials used for work under this Contract shall be new and of the best quality. Used or reconditioned materials or equipment will not be accepted, unless otherwise specified.
- .02 The Contractor is responsible of ensuring that all equipment under the Contract complies with the requirements of the Contract, and in particular, with the requirement of the Specifications for equipment and materials and that all suppliers of such equipment, etc., comply with such requirements. Failure on the part of a supplier to comply with such requirements shall not relieve the Contractor of responsibility for ensuring that the requirements of the Contract have been fulfilled.

**01610 MATERIAL QUALITY**

- .01 It shall be the Contractor's responsibility to ensure that all materials supplied under this Contract are compatible with each other unless specified adjacent materials have been specified herein, or shown on the drawings. For example, form oil and curing compounds used shall be compatible to the damp-proofing materials and shop applied paints shall be compatible with the field finish coats.
- .02 The Contractor shall be required to correct at his own expense any defective work caused by the non-compatibility of materials.

**01620 MATERIALS HANDLING**

- .01 All materials and equipment shall be protected at all times from weather, dust and dirt by the Contractor both before and after installation. The Contractor shall provide temporary housing for all materials, which may be injured by weather, dust or dirt.
- .02 The completeness and integrity of all materials supplied by the Contractor, shall be the responsibility of the Contractor. Such materials as are supplied by AW shall be unloaded and placed in storage by the Contractor at the Contractor's expense. Such materials will be delivered to the site at a location suitable to the supplier. The Contractor shall be responsible for the verification of the completeness, soundness and integrity of the material and upon receipt of such material shall be responsible for the material until it has been incorporated into the project and accepted by AW.

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**01621 FACILITIES FOR FIELD QUALITY CONTROL**

- .01 The Contractor shall provide four (4) concrete thermometers for the exclusive use of AW's Project Manager.
- .02 The Contractor shall supply boxes for storing and curing and crates for transporting concrete cylinders.

**01630 INSPECTION AND REJECTION OF MATERIALS**

- .01 The materials furnished by the Contractor shall be inspected by AW Project Manager at the time of delivery and at such other time as the AW Project Manager may elect, and materials rejected after delivery shall be replaced by and at the expense of the Contractor. All materials furnished and work done by the Contractor shall also be subject to inspection by the AW Project Manager and defective materials shall be removed from the site of the work and defective work repaired or replaced as directed. Facilities for the handling and inspection of materials and work shall, at all times, be furnished by and at the expense of the Contractor, who shall provide suitable and adequate storage room for materials, during the progress of the work and who shall be responsible for any loss of, or damage to, materials until the final acceptance of the completed work.

**01640 STORAGE OF MACHINERY**

- .01 The Contractor shall be governed by the direction of the AW Project Manager in all matters connected with or concerning the storage of machinery on the site and shall at his own cost and expense shift or remove such machinery, immediately upon notice to do so from the AW Project Manager. Such storage of machinery shall not prevent required travel on the street.

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PROJECT CLOSEOUT

**SECTION 01700**

**01700 PROJECT CLOSEOUT**

- .01 Items under this section shall generally be carried out on completion of the Contract except that where directed or approved by the AW Project Manager they may proceed during the project.

**01701 LEAKAGE TESTS**

- .01 All work constructed or installed under this Contract shall be watertight.
- .02 Leakage tests for Watermains shall be carried out in accordance with Specification 02515 – Hydrostatic Testing Of Pipelines.
- .03 Leakage tests for Gravity Sewers and Sanitary Sewer Forcemains shall be carried out in accordance with Specification 02533 – Acceptance Testing For Sanitary Sewers, and Specification 02515 – Hydrostatic Testing Of Pipelines.
- .04 In the event that the leakage test must be repeated due to leakage of the structure or mains, water for the additional tests shall be supplied at the sole expense of the Contractor.
- .05 All sewers, piping, watermains, and other equipment, valves and sluice gates shall meet the leakage tests specified in their respective sections.
- .06 For new concrete construction, each item shall be tested to the overflow level and any visible leaks stopped by an approved method. After these leaks are stopped, leakage tests shall be conducted by measuring the fall of water level in the tanks over a 24-hour period. Allowable leakage shall be less than one-tenth of one per cent per day of the volume contained.
- .07 For units exceeding the allowable leakage, all defects shall be repaired by approved methods and as directed by the AW Project Manager. Tests shall be repeated until the leakage is less than the stipulated amount. If the specified minimum leakage cannot be attained, the AW Project Manager reserves the right to assess a penalty of his own valuation for water loss in excess of the allowable leakage.

**01702 CLEANING AND DISINFECTION**

- .01 The Contractor shall supply all labor, materials and equipment, including the chlorine and water necessary for cleaning and disinfection at his own expense.
- .04 Disinfection of watermains shall be carried in accordance with Specification 02514 – Disinfection Of Water Lines.



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- .05 In the event the water tested is not approved; the Contractor shall repeat the above procedures until water samples meet with approval. All costs will be borne by the Contractor.

**01710 CLEANUP**

- .01 For the duration of the construction period and on completion of the Contract, the Contractor shall remove all equipment, surplus material, debris and rubbish from the site to the approval of the AW Project Manager.
- .02 On or before the completion of the work, except as otherwise specifically directed in writing, the Contractor shall remove all temporary buildings and structures built by him and all construction materials and debris from the site of the Contract. The Contractor shall remove and acceptably disinfect all materials containing organic matter, in, under and around buildings used by him and rubbish of all kinds from any ground which he shall have occupied and shall leave the site in a neat and satisfactory condition.
- .03 The Contractor shall re-erect all fences that are disturbed, in a suitable manner to ensure their stability, and to the approval of the AW Project Manager.
- .04 The Contractor shall satisfactorily check all pipes for their proper support and water tightness and for cleanliness of their interiors.
- .05 The Contractor shall ensure that all equipment is properly operating and satisfactorily calibrated for the service intended and left in a perfectly clean condition.
- .06 The Contractor shall, upon verbal and/or written notice, take immediate steps to repair or make good settlement or defects in the surfaces of backfilled trenches which appear during the period of guaranteed maintenance, or until assumed by AW.
- .07 Should settlement or defects which are, in the opinion of the AW Project Manager, of a dangerous character, develop along the line of work during the guaranteed period, and require immediate repair, the Owner reserves the right of supplying any necessary labor and material to be charged to the Contractor and to be deducted from any monies due or to become due to him without first notifying the Contractor of these defects. The AW Project Manager will, however, immediately notify the Contractor upon completion of such repairs, indicating the cost thereof.
- .08 All buildings, walks, fences, pavements, curbs, gutters, driveways, boulevards, conduits, or transmission lines, which suffer damage due to settlement of any trench or excavation, during the guaranteed period, shall be repaired by the Contractor at his own expense.

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- .09 All culverts, curbs, private sidewalks, and driveways, which are broken, injured or disturbed in the execution of this Contract, are to be restored to their original condition by the Contractor at his own expense.
- .10 All debris, rubbish and scrap pieces resulting from cleanup operations shall become the property of the Contractor and shall be removed from the site in such a manner as to create no nuisance in the streets nor to the adjoining property owners.
- .11 No debris or other material shall be burned without written approval of the Engineer and all necessary permits.

**01717 EQUIPMENT OPERATION & MAINTENANCE MANUAL**

- .01 The submission of the Operation and Maintenance Manuals by the General Contractor among other requirements, is a prerequisite for the issuance of the Substantial Completion Certificate by the AW Project Manager.
- .02 It is the responsibility of the AW Project Manager to ensure that the requirement of this Section be complied with in all respect at the time of the submission of the Operation and Maintenance Manual by the General Contractor.
- .03 The General Contractor shall be required to prepare and submit four (4) copies of documentation, including "As-Constructed" shop drawings, for the operation and associated maintenance of each piece of equipment and system as supplied and installed.
- .04 The General Contractor shall be required to submit the documentation in 8 1/2 x 11 inch BLACK binders ACCO #05426, hot stamped in white lettering on front and spine to accommodate the documentation in accordance with the following division:

VOLUME 1 OPERATION MANUAL  
VOLUME 2 ARCHITECTURAL/STRUCTURAL  
VOLUME 3 MECHANICAL OPERATIONS AND MAINTENANCE  
VOLUME 4 ELECTRICAL AND INSTRUMENTATION OPERATION

The number of volumes shall be increased and renumbered as necessary to accommodate the documentation. Each copy shall be permanently numbered 1 to 4.

- .05 The spine of the binder shall be lettered with the full identification title of the project e.g.

|                             |
|-----------------------------|
| <b>PROJECT NAME</b>         |
| <b>FORT NAME</b>            |
| <b>CONTRACT DESCRIPTION</b> |

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PROJECT CLOSEOUT

**OPERATION AND  
MAINTENANCE  
MANUAL**

**Volume No. of**

and the front face lettered with the following on the respective binders e.g.

**PROJECT NAME  
FORT NAME**

**OPERATION & MAINTENANCE MANUAL**

**CONTRACT: Insert Number**

**VOLUME No. OF**

- .06 The binder shall be arranged in accordance with the Construction Specifications Institute Masterformat - Master List of Sections, Titles and Numbers utilizing laminated mylar plastic divider tabs and color coded accordance to Chapter. Color shall be as follows:

|  |        |
|--|--------|
| i.) Division                                 | White  |
| ii.) Systems                                 | Orange |
| iii.) Certification & Testing                | Green  |
| iv.) Shop Drawings and Maintenance Bulletins | Yellow |
| v.) Safety & Maintenance                     | Red    |

.07 VOLUME I

- i.) LIST OF SUB-CONTRACTORS
- ii.) LIST OF SUPPLIERS
- iii.) LIST OF MAINTENANCE MATERIALS
- iv.) WARRANTIES
- v.) PERFORMANCE TEST REPORTS
- vi.) OPERATIONAL TEST REPORTS
- vii.) MANUFACTURER'S INSTALLATION AND STARTUP CERTIFICATES

.08 VOLUME 2, 3 & 4

- i.) DETAILED TECHNICAL INFORMATION OF EQUIPMENT
- ii.) OPERATION AND MAINTENANCE OF EQUIPMENT
- iii.) SHOP DRAWING OF EQUIPMENT

- .09 For each system and/or equipment, each piece of equipment shall be referred by its tag number and where manufacturer's literature covers several models or options, the

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applicable information shall be highlighted or redundant information crossed out and the required information shall be submitted as follows:

- i.) Index of information in that Chapter in order of appearance
- ii.) Description of system, components and technical data. Include interfaces, sequences, operational characteristic changes for seasonal operation.
- iii.) Maintenance and operating instructions.
- iv.) Recommended spare parts list.
- v.) Schematics, single line, and wiring diagram.
- vi.) Service representatives - names, address, telephone and fax number.
- vii.) Suppliers for replacement parts - name, address, telephone and fax number.
- viii.) Test results and witness testing commissioning test results.
- ix.) Certification, guarantee and warranty.
- x.) Trouble shooting data.
- xi.) Preventative maintenance program complete with suggested checklist sheets.
- xii.) Test data of degreasing and flushing of piping.
- xiii.) Hydrostatic or air tests performance.
- xiv.) Equipment alignment certificates.
- xv.) Balancing data for air and water system.
- xvi.) Equipment tag list.
- xvii.) Inspection approval certificates for all types of systems i.e. plumbing and piping, heating and ventilation, electrical, building etc.

.10 Each binder shall be made up as follows:

- I. Tab: Table of Contents -details the titles of various divisions of the included divider tabs.
- II. Tab: Introduction to Manual - provide written explanation of the layout of the manual and intended use. Include separately the name, address, telephone and fax number of the following:
  - a) Consultant (Engineering Firm)
  - b) General Contractor
  - c) Sub-Contractors
  - d) Distributors
  - e) Manufacturers

.11 The General Contractor is required to submit the Operation and Maintenance Manuals two weeks from the date of the proposed start up of the first piece of equipment or system installed by him.

.12 The AW Project Manager shall not schedule any equipment or system start up with staff unless AW requirements have been fully satisfied.

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ADA BRAC DESIGN/BUILD RFP  
**PRECAST CONCRETE MANHOLES**

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**SECTION 02082**

**PRECAST CONCRETE MANHOLES**

**PART I GENERAL**

.01 SECTION INCLUDES

- A. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.
- B. Precast concrete sanitary sewer manholes with PVC liner where indicated in Drawings.

.02 REFERENCES

- A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings
- B. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. ASTM C 270 - Standard Specification for Mortar for Unit Masonry
- E. ASTM C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- F. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
- G. ASTM C 923 - Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
- H. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- I. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>)
- J. ASTM D 2665 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- K. ASTM D 2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-FiberReinforced Thermosetting-Resin) Pipe
- L. ASTM D 2997 - Standard Specification for Centrifugally Cast "Fiberglass" (Glass-FiberReinforced Thermosetting Resin) Pipe
- M. AWWA C 213 - Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- N. American Association of State Highway and Transportation Officials (AASHTO)

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**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturer's data and details of following items for approval:
  - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
  - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
  - 3. Frames, grates, rings, and covers
  - 4. Materials to be used in fabricating drop connections
  - 5. Materials to be used for pipe connections at manhole walls
  - 6. Materials to be used for stubs and stub plugs, if required
  - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
  - 8. Plugs to be used for sanitary sewer hydrostatic testing
  - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches
- C. Seal submittal drawings by a Professional Engineer registered in the state where the project is being completed.

**PART2 PRODUCTS****.01 PRECAST CONCRETE MANHOLES**

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.
- C. Provide tops to support AASHTO HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.
- D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to

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**PRECAST CONCRETE MANHOLES**

48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Contracting Officer.

- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.
  - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
  - 2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
  - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
  - 4. Internal liquid pressure based on unit weight of 63 pcf
  - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:
  - 1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
  - 2. Wall loading conditions:
    - a. Saturated soil pressure acting on empty manhole
    - b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
  - 3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater
- G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.
- H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

**.02 CONCRETE**

- A. Conform to requirements of Section 03315- Concrete for Utility Construction.
- B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.

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- C. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

**.03 REINFORCING STEEL**

- A. Conform to requirements of Section 03315 - Concrete for Utility Construction.

**.04 MORTAR**

- A. Conform to requirements of Section 04061 - Mortar.

**.05 MISCELLANEOUS METALS**

- A. Provide cast-iron frames, rings, and covers conforming to requirements of Section 02084 - Frames, Grates, Rings and Covers.

**.06 DROP CONNECTIONS AND STUBS**

- A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

**.07 PIPE CONNECTIONS TO MANHOLE**

- A. Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:
  1. External clamps: Type 304 stainless steel
    - a. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
    - b. Internal, expandable clamps on corrosion-resistant manholes:
      - 1) Type 316 stainless steel, 11 gauge minimum
      - 2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion bonded epoxy conforming to AWWA C 213
  2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.

- B. Storm Sewer Connections:

1. Provide watertight connections in accordance with ASTM C 923.

- C. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with



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assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

**.08 SEALANT MATERIALS**

- A. Approved products in accordance with Section 01300 - Submittal Procedures.
- B. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.
- C. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.
- D. Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

**.09 CORROSION RESISTANT MANHOLE MATERIALS**

- A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide the following:

PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Section 02427 - Plastic Liner for Large-Diameter Concrete Sewers and Structures.

**.010 BACKFILL MATERIALS**

- A. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

**.011 NON-SHRINK GROUT**

- A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.
- B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

**.012 VENT PIPES**

- A. Provide external vent pipes for manholes where indicated on Drawings.

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- B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.
- C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:
  - 1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
  - 2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive
  - 3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.
  - 4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Color shall be selected by Project Manager from manufacturer's standard colors.

**.013 PROHIBITTED MATERIALS**

- A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

**.014 MANHOLE LADDER FOR WATERLINE MANHOLES**

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings
  - 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
  - 2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
  - 3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
- B. Provide approved petroleum-based tape encapsulating bolts in access manhole.

**PART3 EXECUTION****.01 EXAMINATION**

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- A. Verify that lines and grades are correct.
- B. Determine if subgrade, when scarified and recompact, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.
- C. Do not build manholes in ditches, swales, or drainage paths unless approved by Contracting Officer.

**.02 PLACEMENT**

- A. Install precast manholes to conform to locations and dimensions shown on Drawings.
- B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

**.03 MANHOLE BASE SECTIONS AND FOUNDATIONS**

- A. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, or concrete foundation slab.
- B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify Contracting Officer for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base.

**.04 PRECAST MANHOLE SECTIONS**

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

**.05 PIPE CONNECTIONS AT MANHOLES**

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
  - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed

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with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.
- B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.
- C. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- D. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- E. Test connection for watertight seal before backfilling.

**.06 INVERTS FOR SANITARY SEWERS**

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
  1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum
  2. Depth of bench to invert:
    - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
    - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
    - c. Pipes larger than 24 inches: equal to largest pipe diameter
  3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.
- B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

**.07 DROP CONNECTIONS FOR SANITARY SEWERS**

- A. Backfill drop assembly with crushed stone wrapped in filter fabric or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 4 inches outside bells.

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- B. Install drop connection when sewer line enters manhole higher than 24 inches above invert of manhole.

.08 STUBS FOR FUTURE CONNECTIONS

- A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

.09 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

.010 BACKFILL

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 02317 - Excavation and Backfill for Utilities.
- B. Where rigid joints are used for connecting existing sewers to manhole, backfill existing sewer up to springline of pipe with Class B concrete or flowable fill.
- C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 02911 - Topsoil. Seed in accordance with Section 02921 - Hydromulch Seeding. When shown on Drawings, sod disturbed areas in accordance with Section 02922 - Sodding.

.011 FIELD QUALITY CONTROL

- A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Section 02533 - Acceptance Testing for Sanitary Sewers.

.012 PROTECTION

- A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to Government.

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**END OF SECTION**

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**FRAMES, GRATES, RINGS AND COVERS****SECTION 02084****FRAMES, GRATES, RINGS, AND COVERS****PART I GENERAL****.01 SECTION INCLUDES**

- A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.
- B. Ring grates.

**.02 REFERENCES**

- A. AASHTO - American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges
- B. ASTM A 48 - Standard Specification for Gray Iron Castings
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. AWS - D 12.1 Welding Reinforcing Steel.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

**PART 2 PRODUCTS****.01 CASTINGS**

- A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers where indicated on Drawings.
- B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

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- C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter, unless indicated otherwise.
- D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

**.02 BEARING SURFACES**

- A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

**.03 SPECIAL FRAMES AND COVERS**

- A. Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

**.04 FINISH**

- A. Unless otherwise specified, uncoated cast iron.

**..05 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS**

- A. Use castings conforming Section 2.01.
- B. One piece casting with dimensions to fit frame and cover.

**PART 3 EXECUTION****.01 INSTALLATION**

- A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.
- B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.
- C. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

**END OF SECTION**



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ADA BRAC DESIGN/BUILD RFP  
**VALVE BOXES, METER BOXES  
AND METER VAULTS**

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**SECTION 02085**

**VALVE BOXES, METER BOXES, AND METER VAULTS**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Valve boxes for water service.
- B. Meter boxes for water service.
- C. Meter vaults for water service.

**.02 REFERENCES**

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturers' product data for following items for approval:
  - 1. Each type of valve box and lid.
  - 2. Each type of meter box and cover.
  - 3. Each type of meter vault frame and cover.
- C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in the State where the project is to be completed.
- D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.

**PART 2 PRODUCTS**

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**VALVE BOXES, METER BOXES  
AND METER VAULTS**

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**.01 VALVE BOXES**

- A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.
- B. Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.
- C. Unless otherwise specified, uncoated cast iron.
- D. Riser Pipe.
  - 1. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Section 02501 - Ductile Iron Pipe and Fittings.
  - 2. Provide single section of pipe.
- E. Concrete for valve box placement:
  - 1. For locations in new concrete pavement, provide strength and mix design of new pavement.
  - 2. For other locations, provide concrete for sidewalks conforming to requirements of Section 02751 - Concrete Paving.

**.02 METER BOXES**

- A. Provide meter boxes for 5/8-inch through 1-inch meters of the following materials:
  - 1. Non-traffic bearing locations: Cast iron, concrete or plastic.
  - 2. Traffic bearing locations: Cast iron.
- B. Provide meter boxes for 1 1/2-inch and 2-inch meters of cast iron.
- C. Provide meter box with reading lid. Provide lids with spring-type latching devices. Lids shall contain sufficient metal that meter box can be easily located with metal detector. Cast words "WATER METER" into lid with letters of 1/2-inch height and raised 3/32 inch.
- D. Meter box dimensions shall conform to the following approximate dimensions:
  - 1. Length: At top -- 15 1/2 inches; at bottom 20 inches
  - 2. Width: At top - 12 1/2 inches; at bottom 14 3/4 inches
  - 3. Height: 12 inches
- E. Extensions: Meter box extensions 3 inches and 6 inches in height shall be available from manufacturer as standard item.

**.03 CAST-IRON METER BOXES**

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- A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.
- B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.
- C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

**.04 CONCRETE METER BOXES**

- A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength. Construct to dimensions shown on Drawings.
- B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

**.05 PLASTIC METER BOXES**

- A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

| <b>ASTM</b> | <b>REQUIREMENT</b>  |
|-------------|---|
| D 256       | Impact Strength = 1.9 ft.-lb./inch (Izod, Notched)                          |
| D 256       | Impact Strength = 6.4 ft.-lb./inch (Izod, Un-Notched)                       |
| D 638       | Tensile Strength (2.0 min.) = 3400 psi                                      |
| D 648       | Deflection Temperature = 170 degrees F                                      |
| D 2240      | Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb. |
| D 790       | Flexural Modulus = 90,000 psi   |

- B. Meter boxes shall meet the following test requirements:
  - 1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
  - 2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.
- C. Meter box body, without lid, shall weigh approximately 7 pounds.

**.06 METER VAULTS**

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- A. Meter vaults may be constructed of precast concrete, or cast-in-place concrete unless a specific type of construction is required by Drawings.
- B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Section 03315 - Concrete for Utility Construction with minimum compressive strength of 4000 psi at 28 days.
- C. Reinforcing steel for meter vaults: Conform to requirements of Concrete for Utility Construction.
- D. Grates and Covers: Conform to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

### **PART 3 EXECUTION**

#### **.01 EXAMINATION**

- A. Obtain approval from Contracting Officer for location of meter vault.
- B. Verify lines and grade are correct.
- C. Verify compacted subgrade will support loads imposed by vaults.

#### **.02 VALVE BOXES**

- A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.
  - 1. Install with bell on top of valve
  - 2. Place riser pipe in plumb, vertical position
- B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.
- C. Set, align, and adjust valve box so that lid is level with final grade.
- D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Contracting Officer, repaint covers black.

#### **.03 METER BOXES**

- A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.
- B. Construct concrete meter boxes to dimensions shown on Drawings.
- C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults, below.

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- D. Do not locate under paved areas unless approved by Contracting Officer. Use approved traffic type box with cast iron lid when meter must be located in paved areas.

**.04 METER VAULTS**

- A. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.
- B. Precast Meter Vaults:
  - 1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Section 02320 - Utility Backfill Materials.
  - 2. Seal lifting holes with non-shrink grout.
- C. Meter Vault Floor Slab:
  - 1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.
  - 2. Precast floor slab elements may be used for precast vault construction.
- D. Cast-in-Place Meter Vault Walls:
  - 1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.
  - 2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
  - 3. Set frame for cover in concrete.

**.05 FRAME AND COVER FOR METER VAULTS**

- A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:
  - 1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
  - 2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

**.06 BACKFILL**

- A. Provide bank run sand in accordance with Section 02320 - Utility Backfill Materials and backfill and compact in accordance with Section 02317 - Excavation and Backfill for Utilities.

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- B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope from top to natural grade.
- C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

**END OF SECTION**

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INLETS AND VALVE BOXES TO GRADE**

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**SECTION 02086**

**ADJUSTING MANHOLES, INLETS, AND VALVE BOXES TO GRADE**

**PART 1 GENERAL**

.01 SECTION INCLUDES

- A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

**PART 2 PRODUCTS**

.01 CONCRETE MATERIALS

- A. Provide concrete, conforming to requirements of Section 03315 - Concrete for Utility Construction.
- B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Section 02082 - Precast Concrete Manholes.
- C. Provide mortar conforming to requirements of Section 04061 - Mortar.

.02 CAST-IRON MATERIALS

- A. Provide cast-iron materials conforming to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

.03 PIPING MATERIALS

- A. For riser pipes and fittings, refer to Sections 02501 - Ductile-Iron Pipe and Fittings through 02528 - Polyethylene Wrap.

**PART 3 EXECUTION**

.01 EXAMINATION

- A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Contracting Officer.

.02 ESTABLISHING GRADE

- A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

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**.03 ADJUSTING MANHOLES AND INLETS**

- A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in the following Sections:
  - 1. Section 02082 - Precast Concrete Manholes
- B. Salvage and reuse cast-iron frame and cover or grate.
- C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.
- D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Contracting Officer's approval.

**.04 ADJUSTING VALVE BOXES**

- A. Salvage and reuse valve box and surrounding concrete block as approved by Contracting Officer.
- B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.
- C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.
- D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

**.05 BACKFILL AND GRADING**

- A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Section 02316 - Excavation and Backfill for Structures.
- B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.
- C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 02911 - Topsoil. Provide seeding in accordance with Section 02921 - Hydro-mulch Seeding, or if sodding in accordance with Section 02922 - Sodding.

**END OF SECTION**



**SECTION 02221****REMOVING EXISTING PAVEMENTS AND STRUCTURES****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Removing concrete paving, asphaltic concrete pavement, brick pavement and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.
- C. Removing pipe culverts, sewers, and sewer leads.
- D. Removing existing inlets and manholes.
- E. Removing and disposing of pre-stressed concrete beams and drill shafts.
- F. Removing miscellaneous structures of concrete or masonry.
- G. Removing existing bridge.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for removing and disposing of asphaltic surfacing with or without base, regardless of thickness encountered, shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction.
  - 2. Payment for removing and disposing of reinforced concrete pavement, with or without asphalt overlay, regardless of its thickness, shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.
  - 3. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction.
  - 4. Payment for removing and disposing of concrete sidewalks and driveways shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction.
  - 5. Payment for removing asphaltic surface course only shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction. This includes removal of existing surface to pavement base.
  - 6. Payment for removing and disposing of miscellaneous concrete and masonry shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction.
  - 7. Payment for removing and disposing of pipe culverts, sewers, and sewer leads

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for each diameter and each material type of pipe removed, shall be included as part of unit price cost for watermain and/or wastewater main (sewer) construction.

8. Payment for removing and disposing of existing inlets is on unit price basis for each inlet removed.
  9. Payment for removing and disposing of prestressed concrete piles and drill shafts is on linear foot basis.
  10. Payment for removing and disposing of existing bridge, including piles and abutments to minimum of 4 feet below ground level, is on a lump sum basis.
  11. Payment for removing and disposing of existing manholes is on unit price basis for each manhole removed.
  12. No payment for saw cutting of pavement, curbs, or curbs and gutters will be made under this section. Include cost of such work in unit prices for watermain and/or wastewater main (sewer) construction items listed in bid form requiring saw cutting.
  13. No payment will be made for work outside maximum payment limits indicated on Drawings, or for pavements or structures removed for Contractor's convenience.
    - a. For utility installations: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
  14. Refer to Measurement and Payment for unit price procedures
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REGULATORY REQUIREMENTS**

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

**PART 2 PRODUCTS - NOT USED****PART 3 EXECUTION****.01 PREPARATION**

- A. Obtain advance approval from the AW Project Manager for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

**.02 PROTECTION**

- A. Protect following from damage or displacement:
  1. Adjacent public and private property.

2. Trees, plants, and other landscape features designated to remain.
3. Utilities designated to remain.
4. Pavement and utility structures designated to remain.
5. Bench marks, monuments, and existing structures designated to remain.

### .03 REMOVALS

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to minimum depth of 2 inches.
- D. When street and driveway saw cut location is greater than one-half of pavement lane width, remove pavement for full lane width or to nearest longitudinal joint as directed by AW Project Manager.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install 8-inch thick masonry plug in pipe end prior to backfill in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

### .04 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

### .05 DISPOSAL

- A. Inlet frames, grates, and plates; and manhole frames and covers, may remain AW property. Disposal shall be in accordance with requirements of AW.
- B. Remove from site, debris resulting from work under this section in accordance with requirements of AW.

**END OF SECTION**

**SECTION 02222****ABANDONMENT OF SEWERS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Abandonment in place of existing sewers, junction structures, manholes, and force mains.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.

1. Payment for grout fill and abandonment of existing sewers, including boxes and elliptical shaped sewers, is on linear foot basis for each diameter of sewer being abandoned. Measurement will be along centerline of sewer from centerline to centerline of manholes.
2. Payment for grout fill and abandonment of sewer manholes or junction structure is by each manhole or junction structure abandoned in conformance with this Section.
3. Payment will be full compensation for all material, equipment, and labor required for complete abandonment grouting, including air venting, testing, temporary plugs, PVC pipes and incidentals.
4. No separate payment will be made for plugging and abandoning sewer force mains. Include cost of such abandonment in related work.
5. Refer to Measurement and Payment for unit price procedures.
6. Acceptability of grout material is based on achieving average strength within range of 75 to 150 psi as defined in Paragraph 2.01B.1. Grout that is out of range after placement may be accepted with price adjustment of 1.0 percent price deduction for each psi average compressive strength below 75 psi and 0.5 percent price deduction for each psi average compressive strength above 150 psi, as applicable to material volume represented by test series. Shrinkage in grout material placements shall be remedied by Contractor according to Paragraph 3.04H without additional compensation.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 DEFINITIONS**

- A. Abandonment. Sewer abandonment consists of demolition and removal of portion of manholes existing within specified depth of surface, and abandonment in place of sewer lines and manholes as specified in this Section.

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- B. Flowable Fill. Flowable fill (abandonment grout) shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. Long-term hardened strength shall be within specified range.
- C. Ballast. Large aggregate either replaced with voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at same time as flowable fill placement.
- D. Backgrouting. Secondary stage pressure grouting to ensure that voids have been filled within abandoned sewer. Backgrouting will only be required at critical locations indicated on Drawings or if there is evidence of incomplete flowable fill placements.

#### .04 REFERENCE STANDARDS

- A. ASTM C 150 - Standard Specification for Portland Cement.
- B. ASTM C 494 - Standard Specification for Chemical Admixture for Concrete.
- C. ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.
- D. ASTM C 937 - Standard Specification for Grout Fluidifier for Pre-placed Aggregate Concrete.
- E. ASTM C 940 - Standard Test Method for Expansion and Bleeding of Freshly Mixed Grout for Replaced Aggregate Concrete in the Laboratory.
- F. ASTM C 1017 - Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
- G. ASTM C 1107 - Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

#### .05 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Flowable fill mix design report:
  - 1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.
  - 2. Use of ballast. Provide percentage of ballast of total placement and size limits for ballast if fill is intended to be used with ballast.
  - 3. Aggregate gradation of fill. Aggregate gradation of mix (excluding ballast) shall be used as pilot curve for quality control during production.
  - 4. Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures

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- including air entrainment or air generating compounds.
- 5. Fill densities and viscosities, including wet density at point of placement.
- 6. Initial time of set.
- 7. Bleeding and shrinkage.
- 8. Compressive strength.
- C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.
- D. Experience record for proposed crew, showing minimum of 100 cubic yards of flowable fill placed using proposed or similar equipment and methods.
- E. At least 60 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

**PART 2 PRODUCTS****.01 FLOWABLE FILL**

- A. Design Mix Criteria. Provide design of one or more mixes to meet design criteria and conditions for placement. Present information required by Paragraph 1.05.B in mix design report including following:
  - 1. Cement: ASTM C 150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.
  - 2. Fly ash: ASTM C 618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.
  - 3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
  - 4. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100, and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.
  - 5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent of natural aggregate to provide workability.
  - 6. Admixtures: Use admixtures meeting ASTM C 494 and ASTM C 1017 as needed to improve pumpability, to control time of set, and reduce bleeding.
  - 7. Fluidifier: Use fluidifier meeting ASTM C 937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
  - 8. Performance additive: Use flowable fill performance additive, such as Darafill or

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approved equal, to control fill properties.

B. Flowable Fill Requirements

1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
2. Placement characteristics: self-leveling.
3. Shrinkage characteristics: non-shrink.
4. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C 940.
5. Minimum wet density: 90 pounds per cubic foot.

.02 BALLAST

- A. Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.
- B. Ballast Composition: Free of regulated waste material.

.03 PLUGS FOR FORCE MAINS

- A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C 1107, Grade B or C.
- B. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

**PART 3 EXECUTION**

.01 PREPARATION

- A. Have fill mix design reports and other submittals required by Paragraph 1.05 accepted by the AW Project Manager prior to start of placement. Notify the AW Project Manager at least 24 hours in advance of grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the AW Project Manager. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

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- D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.
- E. Remove free water prior to starting fill placement.

**.02 EQUIPMENT**

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

**.03 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT**

- A. Remove manhole frames and covers and castings from other existing pipeline structures. Deliver castings to nearest quadrant maintenance facility for future use. Alternatively, salvaged castings may be used upon approval by the AW Project Manager, for constructing new manholes on this project.
- B. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.
- C. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.
- D. Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to Section 02317 - Excavation and Backfill for Utilities. Cut existing force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

**.04 INSTALLATION**

- A. Abandon sewer lines by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.
- B. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.



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- D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.
- G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- H. Remediate placement of flowable fill which does not fill voids in sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.
- I. Plug each end of force main being abandoned.
- J. Force main abandonment
  - 1. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
  - 2. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
  - 3. When using manufactured plug or cap, install fitting as recommended by manufacture's instructions, to form water tight seal.
- K. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 02317 - Excavation and Backfill for Utilities.
- L. Collect and dispose of excess flowable fill material and other debris in accordance with Waste Material Disposal or as directed by the AW Project Manager.

**.05 FIELD QUALITY CONTROL**

- A. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.
- B. Check flow characteristics and workability of fill as placement proceeds.

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- C. Obtain at least three test cylinders for each placement area for determination of 56-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.
- D. Record volume of ballast together with flowable fill placement for same space to demonstrate that voids have been filled.

**.06 PROTECTION OF PERSONS AND PROPERTY**

- A. Provide safe working conditions as required by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

**END OF SECTION**

**SECTION 02233****CLEARING AND GRUBBING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for clearing and grubbing is on per acre basis.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REGULATORY REQUIREMENTS**

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

**PART 2 PRODUCTS - NOT USED****PART 3 EXECUTION****.01 PREPARATION**

- A. Verify that existing plant life and features designated to remain are identified and tagged.

**.02 PROTECTION**

- A. Protect following from damage or displacement:
  - 1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
  - 2. Plants other than trees and landscape features designated to remain.

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3. Utilities designated to remain.
4. Bench marks, monuments, and existing structures designated to remain.

**.03 CLEARING**

- A. Remove stumps, main root ball, and root system to:
  1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.
  2. Depth of 24 inches below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

**.04 REMOVAL**

- A. Remove debris, rubbish, and extracted plant material life from site.
- B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

**END OF SECTION**

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STANDARD SPECIFICATION****ROADWAY EXCAVATION**

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**SECTION 02315****ROADWAY EXCAVATION****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Excavation and compaction of materials for roadways.
- B. Excavation and compaction of materials for roadside ditches.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for roadway excavation shall be included as part of the unit price for watermain and/or wastewater main (sewer) construction.
  - 2. No payment will be made for material excavated under the following conditions:
    - a. More than 2 feet outside of vertical planes behind back of curbs
    - b. For portion within limits of trench for utilities 24-inch and greater constructed by open-cut methods
    - c. As indicated otherwise on Drawings.
  - 3. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.44 ft-lbf/ft<sup>3</sup>).
- B. ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
- C. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 3017 - Standard Test Method for Water content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

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**PART 2 PRODUCTS****.01 MATERIALS**

- A. Provide topsoil conforming to requirements of Section 02911 - Topsoil.
- B. Provide backfill which is excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.
- C. Provide structural backfill which is select material meeting following requirements:
  - 1. Plasticity index: not less than 12 or more than 20.
  - 2. Maximum liquid limit: 45

**PART3 EXECUTION****.01 PREPARATION**

- A. Identify required lines, levels, and datum. Coordinate with Field Surveying.
- B. Identify and flag surface and aerial utilities.
- C. Notify utility companies to remove or relocate utilities.
- D. Identify, stake, and flag known utility locations below grade. Make temporary or permanent relocation of underground pipes, ducts, or utilities where indicated on Drawings.
- E. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify the AW Project Manager and obtain instructions before proceeding in such areas.
- F. Obtain approval of topsoil quality before excavating and stockpiling.

**.02 PROTECTION**

- A. Protect following from damage or displacement:
  - 1. Trees, shrubs, lawns, existing structures, and other features outside of grading limits.
  - 2. Utilities either above or below grade, which are to remain.

**.03 TOPSOIL REMOVAL**

- A. Strip off topsoil from area to be excavated to minimum depth of 6 inches, unless indicated otherwise on Drawings.
- B. Stockpile topsoil in designated location for reuse. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

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**.04 SOIL EXCAVATION**

- A. Excavate to lines and grades shown on Drawings.
- B.** Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact to specified compaction requirements.
- C. Record location and plug and fill inactive water and oil wells. Conform to all local and state requirements. Notify the AW Project Manager prior to plugging wells.
- D. At intersections, grade back at minimum slope of one inch per foot. Produce smooth riding junction with intersecting street. Maintain proper drainage.
- E. When area is inadvertently over excavated, fill area in accordance with specification requirements at no additional cost to AW.
- F. Remove material not qualified for use and excess soil not being reused from site.

**.05 COMPACTION**

- A. Maintain optimum moisture content of subgrade to attain required density.
- B. Compact to following minimum densities at moisture content of optimum to 3 percent above optimum as determined by ASTM D 698, unless otherwise indicated on Drawings:
  - 1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.
  - 2. Other areas: Minimum density of 90 percent of maximum dry density.

**.06 TOLERANCES**

- A. Top of Compacted Surface: Plus or minus 1/2 inch in cross section, or in 16-foot length.

**.07 FIELD QUALITY CONTROL**

- A. Testing will be performed under provisions of Testing Laboratory Services.
- B. Test and analysis of soil materials will be performed in accordance with ASTM D 4318, ASTM D 2216, and ASTM D 698.
- C. Compaction testing will be performed in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017.
- D. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway.
- E. When tests indicate work does not meet specified compaction requirements, recondition, re-compact, and retest at no additional cost to AW.

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**.08 PROTECTION**

- A. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.
- B. Distribute construction traffic evenly over compacted areas, where practical, to aid in obtaining uniform compaction. Protect exposed areas having high moisture content from wheel loads that cause rutting.
- C. Maintain excavation and embankment areas until start of subsequent work. Repair and re-compact slides, washouts, settlements, or areas with loss of density.

**END OF SECTION**



**SECTION 02316****EXCAVATION AND BACKFILL FOR STRUCTURES****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Excavation, backfilling, and compaction of backfill for structures.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
1. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.
  2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 DEFINITIONS**

- A. Unsuitable Material: Unsuitable soil materials are the following:
1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
  4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.
- C. Select Material: Material as defined in Section 02320 - Utility Backfill Materials.
- D. Backfill: Material meeting specified quality requirements, placed and compacted under controlled conditions around structures.
- E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as

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backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

- F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.
- H. Ground Water Control Systems: Installations external to excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of excavation, and depressurization to prevent failure or heaving of excavation bottom.
- I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.
- J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.
- K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on Drawings, and backfilled with foundation backfill material.
- L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

#### .04 REFERENCES

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600kN-mlm<sup>3</sup>)).
- B. ASTM D 1556 - Standard Test Method for Density of Soil in Place by Sand-Cone Method.
- C. ASTM D 2922 - Standard Test Methods for Density of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 3017 - Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
- E. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- F. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).
- G. ASTM D 422 Standard Test Method for Particle-Size Analysis of Soils

**.05 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to the AW Project Manager that procedures meet requirements of Specifications and Drawings.
- C. Submit excavation safety system plan.
  - 1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.
  - 2. Submit excavation safety system plan in accordance with requirements of Trench Safety System, for excavations that fall under State and Federal trench safety laws.
- D. Submit ground and surface water control plan in accordance with requirements in this Section.
- E. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.
- F. Submit project record documents under provisions of Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

**.06 TESTS**

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by AW in accordance with requirements of Testing Laboratory Services and as specified in this Section.
- B. Perform embedment and backfill material source qualification testing in accordance with requirements of Section 02320 - Utility Backfill Materials.

**PART 2 PRODUCTS****.01 EQUIPMENT**

- A. Perform excavation with equipment suitable for achieving requirements of this Specification.
- B. Use equipment which will produce degree of compaction specified. Compact backfill within 3 feet of walls with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to depth of fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

**.02 MATERIAL CLASSIFICATIONS**

- A. Use backfill materials conforming to classifications and product descriptions of Section 02320 - Utility Backfill Materials. Use classification or product description for backfill applications as shown on Drawings and as specified

**PART 3 EXECUTION****.01 PREPARATION**

- A. Conduct an inspection to determine condition of existing structures and other permanent installations.
- B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of local Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where affected by Work, and is considered hazardous to traffic movements.
- C. Perform work in accordance with OSHA standards. Employ an excavation safety system.
- D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.
- E. Install and operate necessary dewatering and surface water control measures..

**.02 PROTECTION**

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.
- E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to AW.

**.03 EXCAVATION**

- A. Perform excavation work so that underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep

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excavation to absolute minimum necessary. No additional payment will be made for excess excavation not authorized by the AW Project Manager.

- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify the AW Project Manager and obtain instructions before proceeding in such areas.
- C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from the AW Project Manager and agency for any repairs or relocations, either temporary or permanent.
- D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.
- E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.
- F. Conduct hauling operations so that trucks and other vehicles do not create dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.
- G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by Work.
- H. Provide sheeting, shoring, and bracing where required to safely complete Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect Work and adjacent structures or improvements. Use sheeting, shoring, and bracing to protect workmen and public.
- I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement stabilized sand, or other material approved by the AW Project Manager and compact to 95 percent standard density.
- J. After completion of structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by the AW Project Manager in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to Work and adjacent structures or improvements.
- K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or other material approved by the AW Project Manager and compact to 95 percent standard density.

#### .04 HANDLING EXCAVATED MATERIALS

- A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at sufficient distance from excavation to prevent slides or cave-ins.

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- B. Provide additional backfill material in accordance with requirements of Section 02319 - Borrow, if adequate quantities of suitable material are not available from excavation and trenching operations at site.

#### .05 DEWATERING

- A. Provide ground water control as required.
- B. Keep ground water surface elevation minimum of 2 feet below bottom of foundation base.
- C. Maintain ground water control as directed and until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of 1.2.

#### .06 FOUNDATION EXCAVATION

- A. Notify the AW Project Manager at least 48 hours prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by the AW Project Manager.
- B. Excavate to elevations shown on Drawings, as needed to provide space for foundation base, forming level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by the AW Project Manager. Prior to placing material over it, recompact subgrade where indicated on Drawings, scarifying as needed, to 95 percent of maximum Standard Dry Density according to ASTM D 698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until 95 percent is achieved, over-excavate to provide minimum layer of 24 inches of foundation backfill material, or other means acceptable to the AW Project Manager.
- C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the AW Project Manager.
- D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.
- E. Remove soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to required subgrade, and replace with foundation backfill material, as directed by the AW Project Manager, at no additional cost to AW.
- F. Place foundation base, or foundation backfill material where needed, over subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.
- G. Use filter fabric as specified in Section 02621 - Geotextile to separate crushed aggregate, and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of 12 inches beyond where another

material stops contact with soil. Place crushed aggregate, and other Class I materials, in uniform layers of 8-inch maximum thickness. Perform compaction by means of at least two passes of vibratory compactor.

.07 FOUNDATION BASE.

- A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, seal slab with minimum thickness of 4 inches may be placed. Extend foundation base minimum of 12 inches beyond edge of structure foundation, unless shown otherwise on Drawings.
- B. Where foundation base and foundation backfill are of same material, both can be placed in one operation.

.08 BACKFILL

- C. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Remove forms, lumber, trash and debris from structures.
  - Unless otherwise shown on the the Drawings, for structures under pavement or within one foot back of curb, use cement stablized sand up to pavement base or subgrade.
  - Unless otherwise shown on the Drawings, for structures not under pavement, use cement stablized sand to within 2 feet of final grade. Use random backfill of suitable material for the top two feet.
- D. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of 85 percent of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until slab or intermediate walls have been placed and concrete has attained sufficient strength.
- E. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.
- F. Maintain backfill material at no less than 2 percent below nor more than 2 percent above optimum moisture content, unless otherwise approved by the AW Project Manager. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698 below paved areas. Compact fill to at least 95 percent around structures below unpaved areas.
- G. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of next layer of backfill.
- H. Place backfill using cement stabilized sand in accordance with Section 02321 - Cement Stabilized Sand.

**.09 FIELD QUALITY CONTROL**

- A. Testing will be performed by an independent Testing Laboratory Services firm as retained by AW.
- B. Tests will be performed initially on minimum of one different sample of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with ASTM D 422. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity.
- C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions:
  - 1. Minimum of one test for every 50 to 100 cubic yards of compacted backfill material as directed by the AW Project Manager.
  - 2. A minimum of three density tests for each full work shift.
  - 3. Density tests will be performed in all placement areas.
  - 4. Number of tests will be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.
  - 5. Identify elevation of test with respect to natural ground.
  - 6. Record approximate depth of lift tested.
- D. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Perform additional moisture-density relationship test once a month or whenever there is noticeable change in material gradation or plasticity.
- E. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

**.010 DISPOSAL OF EXCESS MATERIAL**

- A. Dispose of excess materials in accordance with requirements of the contract documents.

END OF SECTION



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BACKFILL FOR UTILITIES**SECTION 02317****EXCAVATION AND BACKFILL FOR UTILITIES****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.

1. No additional payment will be made for trench excavation, embedment and backfill under this Section. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.
  2. When AW Project Manager directs Contractor to overexcavate trench bottom, Contractor will be paid by unit price bid per linear foot under bid item - 6" Over excavation of Trench Bottom.
    - a. No payment will be paid if AW Project Manager does not direct Contractor to overexcavate trench bottom.
    - b. No over excavation will be measured or paid when unsuitable conditions result from dewatering system not in conformance with Control of Ground Water and Surface Water.
  3. No additional payment will be made for performing Critical Location exploratory excavation. Include cost for unit price for installed underground piping, sewer, conduit, or duct work.
  4. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 DEFINITIONS**

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

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- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
  - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime, fly ash, or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.
- J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
  - 1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water

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- control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
    - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
    - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
  3. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
- N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.
- O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
- P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems.
- S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cavein, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.
- T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.
- U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

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**.04 REFERENCES**

- A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
- B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- K. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

**.05 SCHEDULING**

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

**.06 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit planned typical method of excavation, backfill placement and compaction including:
  - 1. Trench widths.
  - 2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
  - 3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
- C. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.
- D. Submit trench excavation safety program. Include designs for special shoring

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meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.

- E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
- F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to AW Project Manager.

**.07 TESTS**

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by AW.
- B. Perform backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

**.08 SPECIAL SHORING DESIGN REQUIREMENTS**

- A. Have special shoring designed or selected by Contractor's Professional Engineer registered in the state the project is being completed to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

**PART 2 PRODUCTS****.01 EQUIPMENT**

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.
- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

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**.02 MATERIAL CLASSIFICATIONS**

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 02320 - Utility Backfill Materials, and Section 2321 – Cement Stabilized Sand.
- B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Concrete for Utility Construction.
- C. Geotextile (Filter Fabric): Conform to requirements of Section 02621-Geotextile.
- D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

**PART 3 EXECUTION****.01 STANDARD PRACTICE**

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

**.02 PREPARATION**

- A. Maintain barricades and warning lights for streets and intersections affected by Work, and that are considered hazardous to traffic movements.
- B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified and as shown on the contract drawings.
- C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from AW Project Manager and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Section 02221 - Removing Existing Pavements and Structures, as applicable.
- E. Install and operate necessary dewatering and surface-water control measures. Provide stable trench to allow installation in accordance with Specifications.
- F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Field Surveying.

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**.03 CRITICAL LOCATION INVESTIGATION**

- A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.
  - 1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
  - 2. Notify AW Project Manager in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time AW Project Manager is notified of obstruction.
- B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide AW Project Manager with 48 hours notice prior to field excavation or related work.
- C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to AW Project Manager for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S registered in the state the project is being completed.

**.04 PROTECTION**

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to AW.

**.05 EXCAVATION**

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- A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

| <b>Nominal<br/>Pipe Size, Inches</b> | <b>Minimum Trench<br/>Width, Inches</b> |
|--------------------------------------|---|
| Less than 18                         | O.D. + 18                               |
| 18 to 30                             | O.D. + 24                               |
| Over 30                              | O.D. + 24                               |
|                                      |   |

- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify AW Project Manager and obtain instructions before proceeding.
- F. Shoring of Trench Walls.
  - 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
  - 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
  - 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by AW Project Manager. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
  - 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
  - 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent



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of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

- G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
  2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.
  3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
  4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
  5. Conform to applicable Government regulations.
- H. Voids under paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.
- I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company's representative.
- K. When, during excavation to uncover Pipeline Company's pipelines, screwed collar or an oxyacetylene weld is exposed, immediately notify AW Project Manager. Provide supports for collar or welds. Discuss with Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

**.06 HANDLING EXCAVATED MATERIALS**

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- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Section 02320 - Utility Backfill Materials. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of Section 02320 - Utility Backfill Materials.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

**.07 TRENCH FOUNDATION**

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. When wet soil is encountered on trench bottom and dewatering system is not required, overexcavate an additional 6 inches with approval by AW Project Manager. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.
- C. Perform over excavation, if directed by AW Project Manager, in accordance with Paragraph 3.07.B above. Removal of material may be required.
  - 1. Even though Contractor has not determined material to be unsuitable, or
  - 2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating.
- D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

**.08 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION**

- A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.
- C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If

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moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.

- E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.
- H. Place electrical conduit, if used, directly on foundation without bedding.
- I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.
- J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Section 02320 - Utility Backfill Material. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:
  - 1. Class I, II and III Embedment Materials:
    - a. Maximum 6 inches compacted lift thickness.
    - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
    - c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Project Manager.
  - 2. Cement Stabilized Sand (where required for special installations):
    - a. Maximum 6 inches compacted thickness.
    - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
    - c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.
  - 3. Class I Embedment Materials.
    - a. Maximum 6-inches compacted lift thickness.
    - b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
    - c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.

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4. Class II Embedment and Cement Stabilized Sand.
  - a. Maximum 6-inches compacted thickness.
  - b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
  - c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.
- K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

**.09 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION**

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.
- B. For water lines, under pavement and to within one (1) foot back of curb, use backfill materials described by trench limits.
  1. For water lines 20 inches in diameter and smaller use bank run sand or select backfill materials up to pavement base or subgrade.
  2. For water lines 24 inch in diameter and larger, backfill with suitable on-site materials (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.
- C. For sewer pipes under pavement and within one foot back of curb, use backfill materials described by trench limits.
  - For sewer pipes 36 inches in diameter and smaller use cement stabilized sand up to pavement base or subgrade.
  - For sewer pipes 42 inches and larger, backfill with suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.
- D. Where shown on the Drawings, remove unsuitable material from the site and backfill with suitable materials.
- E. Unless otherwise shown on the Drawings, use one of the following trench zone backfills under pavement and to within one foot of edge of pavement. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.
  1. Class I, II, or III or combination thereof:
    - a. Place in maximum 12 inch thick loose layers.

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- b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
    - c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by AW Project Manager.
  - 2. Cement-Stabilized Sand:
    - a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
    - b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
    - c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
  - 3. Class IV A and IV B (Clay Soils):
    - a. Place in maximum 8-inch thick loose layers.
    - b. Compact by vibratory Sheepsfoot Roller to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
    - c. Moisture content within zero percent below or +5 percent above optimum determined according to ASTM D 698, unless approved by Project Manager.
- F. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.
  - 1. Class IV A and Class IV B (Clay Soils) may be used as trench zone backfill outside paved areas.
  - 2. Place in maximum 12-inch loose thick loose lift.
  - 3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
  - 4. Moisture content as necessary to achieve density.
- G. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

**.010 MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES**

- A. Encapsulate manhole, junction box and other pipeline structures with cement stabilized sand, minimum one (1) foot below base, minimum one (1) foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section.

**.011 FIELD QUALITY CONTROL**

- A. Test for material source qualifications as defined in Section 02320 - Utility Backfill Materials.
- B. Provide excavation and trench safety systems at locations and to depths required

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for testing and retesting during construction at no additional cost to AW.

- C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with ASTM D 422. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by AW Project Manager.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.
  - 1. For open cut construction projects and auger pits: Unless otherwise approved by AW Project Manager, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
  - 2. A minimum of three density tests for each full shift of Work.
  - 3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
  - 4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
  - 5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
  - 6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
  - 7. Recompact placement will be retested at same frequency as first test series, including verification tests.
  - 8. Identify elevation of test with respect to natural ground or pavement.
- F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.
- G. Acceptability of crushed rock compaction will be determined by inspection.

.012 DISPOSAL OF EXCESS MATERIAL

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- A. Dispose of excess materials in accordance with requirements of the contract documents.

**END OF SECTION**

**SECTION 02319****BORROW****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Soil materials for embankment.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for borrow is on cubic yard basis calculated by theoretical quantities using average end area method based on Drawings.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
- B. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit location and description of proposed borrow area for approval.
- C. Submit material samples for testing.

**PART 2 PRODUCTS****.01 SOIL MATERIAL**

- A. Grade borrow material used for embankment free of lumps greater than 6 inches, rocks larger than 3 inches, organic material, chemical waste or other contamination, and debris. Take borrow material from sources approved by AW Project Manager.
- B. Use material with plasticity index not less than 12, nor more than 20 when tested in accordance with ASTM D 4318. Maximum liquid limit shall be 45, unless approved by AW Project Manager. Do not use blend of cohesive and granular soils to achieve required plasticity index.



**PART 3 EXECUTION****.01 PREPARATION**

- A. Notify AW Project Manager and testing laboratory 5 days in advance of opening borrow source to permit obtaining samples for qualification testing. When material does not meet specification requirements, locate another source of borrow.
- B. Clear approved source area of trees, stumps, brush, roots, vegetation, organic matter, and other unacceptable material before excavation.

**.02 TESTS**

- A. Test and analyze soil materials in accordance with ASTM D 4318 and ASTM D 2216.

**.03 EXCAVATION**

- A. Provide adequate drainage of surface water so that surface water run off does not enter borrow pit excavation.

**.04 HAULING**

- A. Use covered trucks.

**END OF SECTION**

**SECTION 02320****UTILITY BACKFILL MATERIALS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Material Classifications.
- B. Utility Backfill Materials: 1) Concrete sand 2) Gem sand 3) Pea gravel  
4) Crushed stone 5) Crushed concrete 6) Bank run sand 7) Select backfill  
8) Random backfill
- C. Material Handling and Quality Control Requirements.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No payment will be made for backfill material. Include payment in unit price for applicable utility installation.
  - 2. Payment for backfill material, when included as separate pay item or when directed by AW Project Manager, is on cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawings, or as directed by AW Project Manager.
  - 3. Payment for backfill of authorized over-excavation is in accordance with Section 02318 - Extra Unit Price Work for Excavation and Backfill.
  - 4. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 DEFINITIONS**

- A. Unsuitable Material:
  - 1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  - 3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
  - 4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
  - 1. Materials meeting specification requirements.

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2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.
- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of overexcavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Section 02317 - Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

#### .04 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregate.
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.
- E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

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- G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

**.05 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.
- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off site sources or is being paid as specific bid item.

**.06 TESTS**

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by AW in accordance with Paragraph 3.03.

**PART 2 PRODUCTS****.01 MATERIAL CLASSIFICATIONS**

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01 B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
  - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
    - a. Plasticity index: non-plastic.
    - b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.

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2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
  - a. Plasticity index: non-plastic to 4.
  - b. Gradations:
    - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
    - 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
    - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
  - a. Plasticity index: greater than 7.
  - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
4. Class IVA: Lean clays (CL).
  - a. Plasticity Indexes:
    - 1) Plasticity index: greater than 7, and above A line.
    - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
  - b. Liquid limit: less than 50.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
5. Class IVB: Fat clays (CH)
  - a. Plasticity index: above A line.
  - b. Liquid limit: 50 or greater.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

## .02 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by AW Project Manager. Soils in Class IV B, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Backfill for Structures and Section 02317 - Excavation and Backfill for Utilities.

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- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
  2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
  3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by AW Project Manager, provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
  2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.
- E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

| Sieve   | Percent Passing |
|---------|-----------------|
| 3/8"    | 100             |
| No. 4   | 95 to 100       |
| No. 8   | 80 to 100       |
| No. 16  | 50 to 85        |
| No. 30  | 25 to 60        |
| No. 50  | 10 to 30        |
| No. 100 | 2 to 10         |

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- F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

| Sieve | Percent Passing |
|-------|-----------------|
| 3/8"  | 95 to 100       |
| No. 4 | 60 to 80        |
| No. 8 | 15 to 40        |

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

| Sieve  | Percent Passing |
|--------|-----------------|
| 1/2"   | 100             |
| 3/8"   | 85 to 100       |
| No. 4  | 10 to 30        |
| No. 8  | 0 to 10         |
| No. 16 | 0 to 5          |

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:
1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by AW Project Manager.
  2. Non-plastic fines.
  3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
  4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces.
  5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
  6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
  7. Gradations, as follows:

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| Sieve | Percent Passing by Weight for Pipe Embedment<br>by Ranges of Nominal Pipes Sizes |          |          |
|-------|--|----------|----------|
|       | >15"   | 15" - 8" | < 8"     |
| 1"    | 95 - 100   | 100      |          |
| 3/4"  | 60 - 90  | 90 - 100 | 100      |
| 1/2"  | 25 - 60  | -        | 90 - 100 |
| 3/8"  | -  | 20 - 55  | 40 - 70  |
| No. 4 | 0 - 5  | 0-10     | 0-15     |
| No. 8 | -  | 0 - 5    | 0 - 5    |

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02951 - Pavement Repair and Resurfacing, to meet plasticity criteria.
- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Backfill for Structures and Section 02317 - Excavation and Backfill for Utilities.
- K. Cement Stabilized Sand: Conform to requirements of Section 02321 - Cement Stabilized Sand.
- L. Concrete Backfill: Conform to Class B concrete as specified in Section 03315 - Concrete for Utility Construction.
- M. Flexible Base Course Material: Conform to requirements of applicable portions of Section 02711 - Hot Mix Asphaltic Base Course, Section 02712 - Cement Stabilized Base Course.

### .03 MATERIAL TESTING

- A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
  - 1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
  - 2. Plasticity of material passing No. 40 sieve
  - 3. Los Angeles abrasion wear of material retained on No. 4 sieve
  - 4. Clay lumps
  - 5. Lightweight pieces



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- 6. Organic impurities
- B. Production Testing. Provide reports to AW Project Manager from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.
- C. Assist AW Project Manager in obtaining material samples for verification testing at source or at production plant.

**PART 3 EXECUTION****.01 SOURCES**

- A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that AW Project Manager may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by AW Project Manager, expense for sampling and testing required to change to different material will be credited to AW through change order.
- D. Bank ran sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. AW does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

**.02 MATERIAL HANDLING**

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling, control, and verification testing by AW Project Manager in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

**.03 FIELD QUALITY CONTROL****A. Quality Control**

1. The AW Project Manager may sample and test backfill at:
    - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
    - b. On-site stockpiles.
    - c. Materials placed in Work.
  2. The AW Project Manager may re-sample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing:** AW's testing laboratory will provide verification testing on backfill materials, as directed by AW Project Manager. Samples may be taken at source or at production plant, as applicable.

**END OF SECTION**

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**SECTION 02427**

**PLASTIC LINER FOR LARGE-DIAMETER CONCRETE SEWERS AND STRUCTURES**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Installation of plastic liners for concrete interceptor sewers and structures. Only plastic liners manufactured with integral locking ribs spaced at approximately 2-1/2 inches on center over entire liner is acceptable. Liners relying on mechanically fastened batten strips as primary means of anchorage are unacceptable.

**.02 REFERENCE STANDARDS**

- A. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubber and Thermoplastic Elastomers-Tension.
- B. ASTM D 2440 - Standard Test Methods for Oxidation Stability of Mineral Insulating Oil.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Prior to submittal of shop drawings, manufacturer shall approve proposed panel layout and proposed details. Contractor shall then submit shop drawings showing proposed panel layout to cover area to be lined. Show on shop drawings proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and type of factory and field welds and attachments.
- C. Provide sufficient details to permit placement of liner without use of design Drawings. Reproduction of design Drawings for use as shop drawings will not be allowed. Do not begin fabrication of liner until after shop drawings and submitted materials have been reviewed and accepted by Contracting Officer.

**.04 INSTALLER QUALIFICATIONS**

- A. Applicators. Application of plastic liner to forms and other surfaces, liner finishing, repair, and testing is considered highly specialized work and shall be performed only by firms and individuals recommended and approved by lining manufacturer. Personnel performing such work are to be trained in methods of installation and demonstrate their ability to AW Project Manager.
- B. Welders.

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1. Each welder is to pass qualification welding test before doing welding. Requalification may be required at time deemed necessary by Contracting Officer. Provide at least 24 hours notice to Contracting Officer to schedule qualification welding test.
2. Make test welds in presence of Contracting Officer. Test welds are to consist of following:
  - a. Begin with two pieces of liner, at least 15 inches long and 9 inches wide. Hold pieces in vertical position, lapped 1-1/2 inches.
  - b. Position weld strip over edge of lap and weld to both pieces of liner. Extend each end of weld strip at least 2 inches beyond liner to provide tabs.
3. The weld specimen will be tested as follows:
  - a. Subject each weld strip tab, tested separately, to 10-pound pull normal to face of liner with liner secured firmly in place. Weld is acceptable when there is no separation between weld strip and liner.
  - b. Cut three test specimens from welded sample and tested in tension across welds. Tensile strength measured across welded joints is to be at least 2000 psi when tested in accordance with ASTM D 412. When none of these specimens fails when tested as indicated above, weld will be considered satisfactory.
  - c. If one specimen fails to pass tension test, retest will be permitted. Retest consists of testing three additional specimens cut from original welded sample. When three retest specimens pass test, weld will be considered satisfactory.
4. A disqualified welder may submit new weld sample when welder has had sufficient off-the-job training or experience to warrant re-examination.

## **PART 2 PRODUCTS**

### **.01 MANUFACTURERS**

- A. Plastic liner shall be as manufactured by Ameron Protective Linings Division; Poly-Tee, Inc.; or approved equal.

### **.02 MATERIALS**

- A. Manufacturing.
  1. Manufacture plastic liner sheet, joint, corner and weld strips from high molecular weight thermoplastic polymer compounded to make permanently flexible material suitable for use as protective liner in concrete pipe or other concrete structures. Polyvinyl chloride resin is to constitute not less than 99 percent by weight of resin used in formulation. Copolymer resins will not be permitted.
  2. During manufacture or prior to final acceptance of Work, Contracting Officer

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may sample specimens taken from sheets, strips, or welded joints for testing.

3. Changes in formulation will be permitted only after prior notice is given to Contracting Officer and manufacturer demonstrates that new plastic liner will meet or exceed requirements for chemical resistance and physical properties.

B. Properties.

1. Plastic liner sheets including locking extensions, joints, corners, and welding strips are to be free of cracks, cleavages or other defects adversely affecting protective characteristics of material.
2. Except at shop welds, plastic liner sheets, joint, corner, and weld strips are to have the following properties when tested at 77 degrees F plus or minus 5 degrees F.

| PROPERTY                     | ASTM TEST METHOD         | CHEMICAL RESISTANCE TEST |                                     |
|------------------------------|--------------------------|--------------------------|-------------------------------------|
|                              |                          | INITIAL                  | AFTER CHEMICAL EXPOSURE<br>(Note 1) |
| Tensile strength,            | D 412, Die B             | 2200 psi                 | 2100 psi                            |
| Elongation at break,<br>min. | D 412, Die B             | 200<br>percent           | 200 percent                         |
| Shore durometer,<br>Type D   | D 2240, Within 1<br>sec. | 50-60                    | ± 5 (Note 2)                        |
|                              | D 2240, 10 sec.          | 35-50                    | ± 5 (Note 2)                        |
| Weight change                | (Note 3)                 | -----                    | ± 1.5 % (Note 2)                    |

Notes:

1. For 112 days in chemical solutions
2. With respect to initial test results
3. Specimen to be 1 inch x 3 inch sample sheet thickness, taken from sheet or strip prior to final acceptance of work.

.03 MATERIAL TESTS

- A. Material Properties. Test samples taken from sheets, joints or weld strips to determine material properties. Determine PVC tensile strength and elongation in accordance with ASTM D 412 using Die B. Determine indentation hardness in accordance with ASTM D2240 using Type D durometer, except that single thickness of material will be used. Determination of change of weight and indentation hardness is to be made of 1-inch by 3-inch specimens. Thickness of specimens shall be thickness of sheet or strip.
- B. Measurement of Initial Physical Properties. Determine initial values for tensile strength, weight, elongation and indentation hardness prior to chemical resistance tests.

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C. Chemical Resistance Tests.

1. Determine physical properties of specimens after exposure to chemical solutions. Condition test specimens to constant weight at 110 degrees F before and after submersion in the following solutions for period of 112 days at 77 degrees F plus or minus 5 degrees F.

| <u>Chemical Solution</u>                         | <u>Concentration</u>          |
|--|-------------------------------|
| Sulfuric acid                                    | 20 % *                        |
| Ammonium hydroxide                               | Sodium hydroxide 5%           |
| Nitric acid                                      | 5% *                          |
| Ferric chloride                                  | 1% *                          |
| Soap   | 1                             |
| Detergent (linear alkyl benzyl sulfonate or LAS) | 0.1%<br>BOD not less than 700 |
| Bacteriological                                  | ppm                           |

\*Volumetric percentages of concentrated C.P. grade reagents

2. At 28 day intervals, remove specimens from each chemical solution and test. When specimen fails to meet 112-day property requirements specified in paragraph 2.02B before completion of 112-day exposure, material will be rejected.

- D. Pull Test for Locking Extensions. Liner locking extensions embedded in concrete are to withstand test pull of at least 100 pounds per linear inch, applied perpendicularly to concrete surface for period of 1 minute, without rupture of locking extensions or withdrawal from embedment. Perform this test at temperature between 70 degrees F and 80 degrees F, inclusive.
- E. Shop-Welded Joints. Shop-welded joints used to fuse individual sections of liner together, are to meet minimum requirements of liner for thickness, corrosion resistance and impermeability. Welds shall show no cracks or separations and be tested for tensile strength. Tensile strength, measured across welded joint in accordance with ASTM D 412 using Die B, shall be at least 2000 psi. Test temperature is to be 77 degrees F plus or minus 5 degrees F and use measured minimum width and thickness of reduced test specimen section.
- F. Spark Test. Shop and field test liners for holidays or flaws using an approved spark tester set to provide minimum of 20,000 volts (Tinker and Rasor Model AP-W with power pack, or approved equal). Satisfactorily repair sheets having holes in shop prior to shipment from manufacturer's plant. Repairs shall be made by welders qualified in accordance with these specifications.

.04 MATERIAL DETAILS AND DIMENSIONS

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- A. Approval of Details. Liner sheet, strip, and other accessory pieces are to conform to requirements of these Specifications.
- B. Thickness of Material. Minimum thickness of PVC sheet and strip shall be as follows:

| <u>Material</u>                    | Thickness in Inches |
|------------------------------------|---------------------|
| Sheet, integral locking extensions | 0.065               |
| Sheet, plain                       | 0.094               |
| Joint strip                        | 0.094               |
| Weld strip                         | 0.125               |

- C. Material Sizes. Use pipe-size sheets for sheets of PVC liner to provide coverage required by Drawings. Structural sheets are to be standard 48-inches by 96-inches, with special size noted on shop drawings. Lengths specified shall include tolerance at ratio of plus or minus 1/4-inch for each 100 inches, or 0.25 percent. Joint strips shall be 4 inches plus or minus 0.25 inch in width and have each edge beveled prior to application. Weld strips shall be 1 inch plus or minus 0.125 inch in width. Weld strips are to have edges beveled at time of manufacture.
- D. Locking Extensions.
1. No polygrip-type holding or locking extension will be permitted.
  2. PVC liner to be embedded in concrete is to have integral locking extensions. Liner may not be bonded to concrete surfaces with adhesives except as specifically approved by Contracting Officer.
  3. PVC locking extensions are to be same material as liner, be integrally molded or extruded with sheets, and have an approved cross section with minimum height of 0.375 inch and minimum web thickness of 0.085 inch. They are to be approximately 2.5 inches apart and be such that when extensions are embedded in concrete, liner will be held permanently in place.
  4. PVC locking extensions are to be parallel and continuous except where interrupted for joint flaps, weep channels, strap channels and for other purposes shown on Drawings or approved by Contracting Officer.
  5. The liner sheet edge which will be lower terminal edge in structure is not to extend beyond base of final locking extension more than 0.375 inch.
- E. Provisions for Strap Channels. Unless alternate methods are acceptable to Contracting Officer, liner required to be secured to inner form with straps are to have strap channels at not more than 20 inches on center perpendicular to locking extensions. Strap channels are to be maximum of 1-inch wide and formed by removing locking extensions so that maximum of 3/16-inch remains. Channels are not to be provided in final two locking extensions adjacent to terminal edge of liner coverage.

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- F. Flaps. When transverse flaps are specified or required, fabricate by removing locking extensions so that no more than 1/32 inch of base of locking extensions remains on sheet.
- G. Adhesive Products. Adhesive products and application procedures used in installation of liner are to be according to manufacturer's recommendations. Adhesive products intended for use inside cast-in-place structures are to be non-flammable.
- H. Cleaners. Cleaners used in installation of liner shall be approved by Contracting Officer prior to use. Cleaners are to be nonflammable and water soluble or water dispersible and not be detrimental to plastic liner.
- I. Caulking Products. Caulking products and application procedures used in installation of liner and appurtenances are to be as recommended by manufacturer.
- J. Mechanical Anchors. When approved for use with plain sheet liner, provide anchors and washers of Type 316 stainless steel, and as recommended by liner manufacturer.

**PART 3 EXECUTION****.01 NOTIFICATION**

- A. Notify Contracting Officer at least 24 hours before reinforcing steel placement so that lining may be inspected and errors corrected without delaying Work.

**.02 PLACING LINER**

- A. Location. Place liner throughout entire length of interceptor sewer along top 300 degrees of pipe circumference, and inside structures as indicated on Drawings. Liner is to be applied and secured to forms and inspected by Contracting Officer prior to placement of reinforcing steel.
- B. Coverage.
  - 1. In cast-in-place structures, no offset of lower terminal edge is permitted. Unless otherwise shown on Drawings, lower terminal edge is to be one foot below low water level or 6 inches below top of grout or concrete fillet, whichever is higher.
  - 2. At station where there is difference in pipe's circumferential liner coverage, as shown on Drawings, and longitudinal terminal edges of liner downstream from that station are lower than those upstream, uniformly slope terminal edges of liner installed in section of pipe or structure immediately upstream from station for entire length of section of pipe or structure from limits of smaller coverage to those of greater coverage. Wherever longitudinal terminal edges of liner downstream from station are higher than those upstream, accomplish slope uniformly throughout length of section of pipe or structure immediately downstream from station. Provide an approved locking extension along sloping lower terminal edges of liner plate.
- C. Positioning Liner.



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1. Position PVC liner installed in pipe so that locking extensions are parallel to longitudinal axis of pipe.
  2. Position PVC liner installed in cast-in-place structures so that locking extensions are parallel to direction of concrete placement, which is normally vertically for vertical walls.
  3. Closely fit liner to inner forms. Cut sheets to fit curved and warped surfaces using minimum number of separate pieces.
  4. The Contracting Officer may require use of patterns or marking of sheet layouts directly on forms where complicated warped surfaces are involved.
  5. At transverse joints between sheets of liner used in cast-in-place structures and pipe joints, space between ends of locking extensions, measured longitudinally, shall not exceed 4 inches. Where sheets are cut and joined for purpose of fitting irregular surfaces, this space shall not exceed 2 inches.
- D.     Securing Liner in Place.
1. Liner shall be held snugly in place against inner forms. For pipes and similar circular sections, use light steel banding straps or other approved means. Prefabricated pipe-size tubular sheets which do not require strap channels may also be used.
  2. When used, place banding straps in strap channels, as specified under provision for strap channels, at spacing not to exceed 20 inches.
  3. Any method of banding, other than in strap channels, shall be reviewed by Contracting Officer prior to use.
  4. On vertical surfaces where form ties or form stabilizing rods pass through liner, make provisions to maintain liner in close contact with forms during concrete placement. These provisions shall be reviewed by Contracting Officer.
  5. Prevent concrete from flowing around edges of sheets at joints by sealing joint or seam with waterproof tape recommended by manufacturer.
  6. Forms in contact with plastic liner need not be oiled.
- E.     Weep Channels.
1. At each pipe joint and at transverse joints in cast-in-place structures, gap not less than 2 inches nor greater than 4 inches shall be left in locking extensions to provide transverse weep channel. When locking extensions are removed to provide weep channel at joints, base of extension left on sheet shall not exceed 3/16 inch.
  2. Provide intermediate weep channels as required to maintain maximum spacing of 8 feet. Intermediate weep channels shall not be less than 2.0 inches nor greater than 4.0 inches in width. When locking extensions are removed to provide intermediate weep channels, base of extension left on sheet shall not exceed 3/16 inch.
  3. Any area behind liner, which is not properly served by regular weep channels, shall have additional weep channels 2 inches wide provided by cutting away locking

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extensions.

4. Provide transverse weep channel approximately 12 inches away from each liner return where surfaces lined with plastic liner join surfaces which are not so lined.
5. As part of work of installing liner, clear outlets of weep channels of obstructions which would interfere with their proper functions.
6. Design weep channels for external hydrostatic pressures of water column equal in height to greater of 50 feet (22 psi) or 1.1 times depth of burial.

F. Liner Returns.

1. Install liner return where shown on approved shop drawings and wherever surfaces lined with plastic liner joins surfaces which are not so lined.
2. Unless otherwise indicated by Drawings or approved shop drawings showing liner installation methods, make returns as follows:
  - a. Return liner at least 3 inches at surfaces of contact between concrete structure and items not concrete (including access frames, gate guides and pipe penetrations).
  - b. Follow the same procedure at joints where type of protective lining is changed, or new work is built to join existing unlined concrete.
3. Provide locking extensions on returns to lock returns to concrete of plastic-lined, cast-inplace structures.
4. Seal each liner return to adjacent construction with which it is in contact by means of an adhesive system recommended by manufacturer and acceptable to Contracting Officer. When joint space is too wide or joint surfaces too rough to permit use of compound, fill joint space with 2 inches of densely caulked cement mortar, lead wool, or other caulking material and finished with minimum of 1 inch depth of an approved corrosion resistant sealant material.

.03 CONCRETING OPERATIONS

A. Concrete Placement.

1. Carefully vibrate concrete placed against liner shall be so as to avoid damage to liner and to produce dense concrete securely anchoring locking extensions into concrete. Use external vibrators in addition to internal vibrators, particularly along lower terminal edge of liner.
2. Stiffeners, when used along locking extensions of liner installed in forms for pipe, shall be withdrawn completely during placement of concrete in forms. Revibrate concrete to consolidate concrete in void spaces caused by withdrawal of stiffeners.

B. Removing Forms.

1. In removing forms, take care to protect liner from damage. Do not use sharp instruments to pry forms from lined surfaces. When forms are removed, pull nails that remain in liner plate without tearing liner and clearly mark resulting holes. Mark form tie holes before ties are broken off. Mark areas of abrasion of liner.

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2. Following completion of form removal, clean liner in pipe and structures for inspection.
3. Remove banding straps used in securing liner to forms for pipe and cast-in-place structures within limits of unlined invert.

**.04 FIELD JOINTING OF LINER****A. Installation Requirements.**

1. No field joint shall be made in liner until lined pipe or structure has been backfilled and 7 days have elapsed after flooding or jetting has been completed. Where ground water is encountered, joint shall not be made until pumping of ground water has been discontinued for at least 7 days and no visible leakage is evident at joint. Liner at joints shall be free of mortar and other foreign material and be clean and dry before joints are made.
2. Hot joint compound shall not be brought in contact with liner.
3. No coating shall be applied over joint, corner or welding strip, except where nonskid coating is applied to liner surfaces.

**B. Field Joints in Pipe Installation.**

1. Field joints in lining at pipe joints shall be one of the following types:
  - a. Type P-1. Make joint with separate 4-inch joint strip and two welding strips. Center 4-inch joint strip over joint, heat-sealed to lining, then welded along each edge to adjacent liner sheets with 1-inch weld strip. 4-inch joint strip shall lap over each sheet minimum of 1/2 inch.
  - b. Type P-2
    - 1) Make joint with joint flap with locking extensions removed as described in paragraph 2.04 above, and extending approximately 4 inches beyond pipe end. Joint flap shall overlap lining in adjacent pipe section minimum of 1/2 inch and be heat-sealed in place prior to welding. Complete field joint by welding flap to lining of adjacent pipe using 1-inch weld strip.
    - 2) Take care to protect flap from damage. Avoid excessive tension and distortion in bending back flap to expose pipe joint during laying and joint mortaring. At temperatures below 50 degrees F heating of liner may be required to avoid damage.
2. Do not make field joints in liner at pipe joints until mortar in pipe joint, when used, has been allowed to cure for at least 48 hours.
3. Joints between lined pipe and lined structures are to be either Type C-1 joint or Type C-2 joint as described below.

**C. Field Joints in Concrete Structures.** Field joints in liner on concrete structures are to be one of following types:

1. Type C-1. Make joint with separate 4-inch joint strip and two welding strips.

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Center flinch joint strip over joint, heat-sealed to liner, then welded along each edge to adjacent sheets with 1-inch wide weld strip. Width of space between adjacent sheets is not to exceed 2 inches. 4-inch joint strip is to lap over each sheet minimum of 1/2 inch. It may be used at transverse or longitudinal joint.

2. Type C-2. Make joint by lapping sheets not less than 1/2 inch. One 1-inch weld strip is required. Upstream sheet is to overlap one downstream. Heat-seal lap into place prior to welding on 1-inch weld strip.
3. Type C-3. Make joint by applying 2-inch wide waterproof tape or 1-inch wide welding strip on back of maximum 1/4-inch gap butt joint or by some other method approved by Project Manager to prevent wet concrete from getting under sheet. After forms have been stripped, apply 1-inch weld strip over face to sheet.

D. Installation of Welding Strips.

1. All welding of joints is to be in strict conformance with specifications and instructions of lining manufacturer.
2. Welding is to fuse both sheets and weld strip together to provide continuous joint equal in corrosion resistance and impermeability to liner plate.
3. Hot-air welding tools shall provide effluent air to sheets to be joined at temperature between 500 degrees F and 600 degrees F. Hold welding tools approximately 1/2 inch from and moved back and forth over junction of two materials to be joined. Move welding tool slowly enough as weld progresses to cause small bead of molten material to be visible along both edges and in front of weld strip.
4. Maintain adequate ventilation in confined spaces during welding operations.
5. After repairs have been made, defective welds will be re-inspected and re-tested.

E. Joint Reinforcement. Apply 12-inch long welding strip as reinforcement across each transverse joint and weep channel which extends to lower terminal edge of liner. Center reinforcement strips over joint being reinforced and located as close to lower edge of liner as practicable. Weld in place after transverse welding strips have been installed.

F. Application of Liner to Concrete Surfaces with Adhesives. Application of liner plate to concrete surfaces by means of adhesive is allowed only where shown on Drawings for existing structures, or where specifically acceptable to Contracting Officer and called out on approved shop drawings, and is to be accomplished by following steps:

1. Etch concrete surface by abrasive blasting to develop slightly granular surface.
2. After abrasive blasting, thoroughly clean concrete surface of dust.
3. Apply primer, adhesive and liner in strict accordance with manufacturer's recommendations, as approved by Contracting Officer.
4. Place mechanical anchors at 12-inch centers each way after adherence of liner to concrete surface has been achieved. Place anchors after adhesive system has cured for minimum of 24 hours. Seal penetration of liner by anchor in accordance with manufacturer's recommendations.

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- G. Nonskid Surfaces. Surfaces of liner, shown on Drawings to be nonskid, treated as follows prior to installation:
1. Liner is to be cleaned, dried, and spread with an adhesive coating recommended by manufacturer of liner plate.
  2. Liberally sprinkle surface with clean, dry, well graded sand, which will pass No. 30 sieve but be retained on No. 70 sieve.
  3. After sanded surface has thoroughly dried, brush away excess sand and spray seal coat of adhesive coating over sand in sufficient quantity to coat and bond sand to liner plate.
  4. Allow coated sand surface to dry thoroughly before handling.
- H. Protection and Repair of Liner.
1. Take necessary measures and precautions to prevent damage to liner from equipment and materials used in or taken through Work. Repair damage to installed liner plate in accordance with requirements for repair of liner.
  2. Patch nail and tie holes and cut, torn and seriously abraded areas in liner plate. Patches made entirely with welding strip are to be fused to liner over entire patch. Use of this method is limited to patches which can be made with single welding strip. Use of parallel, overlapping or adjoining welding strips will not be permitted. Larger patches may consist of smooth liner over damaged area, with edges covered with welding strips fused to patch and to liner adjoining damaged area. Limit size of single patch of latter type only as to its width, which shall not exceed 4 inches.
  3. Whenever liner is not properly anchored to concrete, or whenever patches larger than those permitted above are necessary, accomplish repair of liner and restoration of anchorage by injecting epoxy grout behind liner plate by method approved by Contracting Officer. Use of adhesives will not be allowed to repair improperly anchored liner plate.
- I. Field Tests.
1. Upon completion of installation, clean surface of liner to permit visual inspection and spark testing by Contractor under supervision of Contracting Officer, using spark-type detector complying with requirements for Spark Test. Properly repair and retest areas of liner failing to meet field test.
  2. Contractor is to assist in inspection and spark testing by providing adequate ventilation, ladders for access, barricades or other traffic control devices, and is responsible for opening and closing entrances and exits.
  3. Spark testing of liner by Contractor under supervision of Contracting Officer is to be done with detector complying with these Specifications.

**END OF SECTION**

**SECTION 02441****MICROTUNNELING AND PIPE-JACKED TUNNELS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Tunnel construction of sewers by one-pass methods with or without man entry. Construction methods involve jacking pipe following hand-shield excavation or tunnel boring machine (TBM) or micro-tunnel boring machine (MTBM), with pipe serving as both tunnel liner during construction and sewer pipe after completion of construction.
- B. Select centrifugally-cast fiberglass pipe (FRP), vitrified clay pipe (VCP), reinforced concrete pipe (RCP) for storm or sanitary sewers. Use plastic-lined RCP for sanitary sewers. Unlined RCP or RCP lined with liner other than that specified in Section 02427 - Plastic Liner for Large-diameter Concrete Sewers and Structures will not be allowed for sanitary sewers.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Length of sewer installed will be measured by linear foot along center line of completed sewer from center line to center line of manholes, as designated on Drawings; and to end of stubs or termination of pipe; and to inside face of lift station and treatment plant works. Installation of sewer within limits of structure other than manholes will not be considered for measurement and payment at unit price bid.
  - 2. Payment will include and be full compensation for labor, equipment, materials, and supervision for construction of sewer and excavation, complete in place including disposal of excess materials, sheeting, shoring or bracing, dewatering, utility adjustments, connections to existing sewers, grouting when required, tests, backfilling, clean-up, and other related work necessary for construction as specified or as shown on Drawings.
  - 3. Payment for installation of sewer will be authorized by AW Project Manager in two parts. Pay estimates for partial payments will be made as measured above according to following schedule:
    - a. 95 percent payment will be made for jacked pipe installed but not yet grouted, in cases where grouting is specified.
    - b. 100 percent payment will be authorized on linear foot basis for amount of jacked sewer pipe installed, including grouting when specified.
  - 4. Monitoring will be paid for at lump sum price for installations, observations, and reporting.

- B. Stipulated Price (Lump Sum): If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

### .03 REFERENCE STANDARDS

- A. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
- B. American Association of State Highway and Transportation Officials (AASHTO).
- C. Occupational Safety and Health Administration (OSHA).
- D. National Electrical Code - (NFPA 70).

### .04 DEFINITION

- A. Jacked Pipe. Method for installing sewer pipe that serves as initial construction lining and tunnel support, installed for stability and safety during construction, and as sewer pipe. Pipe is shoved forward, or jacked, as tunnel is advanced.
- B. Microtunneling. Method of installing pipe by jacking pipe behind microtunnel boring machine which is connected to and shoved forward by pipe being installed, generally precluding man entry.
- C. Tunnel Boring Machine (TBM). Mechanized excavating equipment that is steerable, guided and articulated, connected to and shoved forward by pipe being installed, with man entry.
- D. Microtunnel Boring Machine (MTBM). Mechanized excavating equipment that is remotely controlled, steerable, guided and articulated, connected to and shoved forward by pipe being installed, usually precluding man entry.
- E. Tunneling Methodology. Written description, together with supporting documentation that defines plans and procedures for microtunneling or pipe jacking operations.
- F. Zone of Active Excavation. Area located within radial distance about surface point immediately above face of excavation equal to depth to bottom of excavation.
- G. Critical Structure. Building, structure, bridge, pier, or similar construction partially or entirely located within zone of active excavation.

### .05 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Following submittals are required:
  - 1. Tunneling Methodology. Brief description of proposed tunnel methodology. Description should be sufficient to convey following:
    - a. Proposed method of tunnel construction and type of face support.

- b. Manufacturer and type of tunneling equipment proposed; type of lighting and ventilation systems.
  - c. Number and duration of shifts planned to be worked each day.
  - d. Sequence of operations,
  - e. Locations of access shafts and work sites.
  - f. Method of spoil transportation from face, surface storage and disposal location.
  - g. Capacity of jacking equipment and type of cushioning.
  - h. Identify critical utility crossings and special precautions proposed.
2. Drawings and Calculations: Submit for record purposes, drawings and calculations for tunnel support system. Provide adequate drawings and installation details for construction. For pipe jacking and microtunneling, show pipe and pipe joint detail. Documents must be signed and sealed by Professional Engineer registered in the state where the project is being completed. Calculations shall include clear statement of criteria used for design as described in Paragraph 1.06, Design Criteria.
3. Quality Control: Submit for review brief description of quality control methods including:
  - a. Method and frequency of survey control.
  - b. Example of tunnel daily log.
4. Geotechnical Investigation: When geotechnical investigations are conducted, submit results to Project Manager for record purposes.
5. Monitoring Plans:
  - a. Instrumentation Monitoring Plan: Submit for review, prior to construction, monitoring plan that includes schedule of instrumentation design, layout of instrumentation points, equipment installation details, manufacturer's catalog literature, and monitoring report forms.
  - b. Surface Settlement Monitoring Plan. Submit settlement monitoring plan for review prior to construction. Identify on plan location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.
6. Structures Assessment. Provide preconstruction and post construction assessment reports for critical structures, namely those located within zone of active excavation from proposed tunnel centerline. Include photographs or video of existing damage to structures in vicinity of sewer alignment in assessment reports.
7. Readings of all monitoring shall be submitted to Project Manager.
8. Daily Reports: Maintain shift log as defined in Paragraph 3.04, Pipe jacked Tunneling Data, and make available to AW Project Manager on request.

#### .06 DESIGN CRITERIA

- A. Assume responsibility for selection of appropriate pipe and pipe joints to carry thrust of any jacking forces or other construction loads in combination with



overburden, earth and hydrostatic loads. Design of any pipe indicated on Drawings considers in-place loads only and does not take into account any construction loads. Criteria for longitudinal loading (jacking forces) on pipe and joints shall be determined, based on selected method of construction.

- B. Jacked pipe shall be designed to withstand thrust from MTBM, TBM or shield and pipe advance without damage or distortion. Propulsion jacks shall be configured so that thrust is uniformly distributed and will not damage or distort pipe.
- C. Take into account loads from handling and storing.
- D. Criteria to be used at railroad crossings shall be Cooper E-80 locomotive loading distributions in accordance with AREMA specifications for culverts. In design, account for additive loadings due to multiple tracks.
- E. Criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.
- F. Provide pipes of diameter shown on Drawings. Substitution of pipe with larger diameter to suit MTBM or TBM equipment availability will only be permitted if demonstrated to satisfaction of AW Project Manager that design flows and velocities can be achieved.

## **PART 2 PRODUCTS**

### **.01 SEWER PIPE**

- A. Assume responsibility for selecting appropriate pipes and pipe joints to safely carry loads imposed during construction, including jacking forces. Pipe joints shall be flush with outside pipe face when pipes are assembled. Pipe materials shall be selected from following:
- B. Plastic-lined reinforced concrete pipe with joints and fittings to be in accordance with Section 02427 - Plastic Liner for Large-Diameter Concrete Sewers and Structures. Plastic liner is not required for storm sewers.
- C. Use pipe that is round with smooth, even outer surface, and has joints that allow for easy connections between pipes. Design pipe ends so that jacking loads are evenly distributed around entire pipe joint and such that point loads will not occur when pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by process of installation, as well as final in-place loading conditions. Protect driving ends of pipe and joints against damage.

## **PART 3 EXECUTION**

### **.01 CONSTRUCTION OPERATIONS CRITERIA**

- A. Use methods for microtunneling and pipe jacked tunneling operations that will minimize ground settlement. Select method which will control flow of water

and prevent loss of soil into tunnel and provide stability of face under anticipated conditions.

- B. Conduct tunneling operations in accordance with applicable safety rules and regulations, OSHA standards and Contractor's safety plan. Use methods which include due regard for safety of workmen, adjacent structures, utilities, and public.
- C. Maintain clean working conditions wherever there is man access.
- D. For tunneling under railroad embankments, highways, or streets, perform installation so as to avoid interference with operation of railroads, highways, or streets, except as approved by owner of facility.

## .02 GROUND WATER CONTROL

- A. Provide ground water control measures in conformance with Control of Ground Water and Surface Water, when necessary to perform Work.

## .03 EQUIPMENT

- A. Full directional guidance of shield, TBM, or MTBM is prerequisite of this method of construction.
- B. Assume responsibility for selection of tunneling equipment which, based on past experience, has proven to be satisfactory for excavation of soils to be encountered.
- C. Employ tunneling equipment that will be capable of handling various anticipated ground conditions and is capable of minimizing loss of soil ahead of and around machine and shall provide satisfactory support of excavated face.
- D. Tunnel Boring Machine (TBM). A TBM used for pipe-jacking shall conform to shape of tunnel with uniform perimeter that is free of projections that could produce over- excavation or voids. Appropriately sized overcutting bead may be provided to facilitate steering. In addition it shall:
  - 1. Be capable of full face closure.
  - 2. Be equipped with appropriate seals to prevent loss of bentonite lubricant.
  - 3. Be capable of correcting roll by reverse drive or fins.
  - 4. Be designed to handle adverse ground conditions including ground water ingress.
  - 5. Be equipped with visual display to show operator actual position of TBM relative to design reference.
- E. Tunnel Shield. If hand shield is used for pipe jacked tunneling (with or without attached mechanized excavating equipment), shield must be capable of handling various anticipated ground conditions. In addition, shield shall:
  - 1. Conform to shape of tunnel with uniform perimeter that is free of projections that could produce over-excavation or voids. Appropriately-sized overcutting bead may be provided to facilitate steering.

2. Be designed to allow face of tunnel to be closed by use of gates or breasting boards without loss of ground.
- F. Microtunneling Equipment. In case of MTBM, use spoil transportation system which:
1. Balances soil and ground water pressures by use of slurry or earth pressure balance system; system shall be capable of adjustments required to maintain face stability for particular soil condition and shall monitor and continuously balance soil and ground water pressure to prevent loss of slurry or uncontrolled soil and ground water inflow, or, in case of slurry spoil transportation system:
    - a. Provides pressure at excavation face by use of slurry pumps, pressure control valves, and flow meter.
    - b. Includes slurry bypass unit in system to allow direction of flow to be changed and isolated, as necessary.
    - c. Includes separation process. Design it to provide adequate separation of spoil from slurry so that slurry with sediment content within limits required for successful tunneling can be returned to cutting face for reuse. Appropriately contain spoil at site prior to disposal.
    - d. Uses type of separation process suited to size of tunnel being constructed, soil type being excavated, and work space available at each work area for operating plant.
    - e. Allows composition of slurry to be monitored to maintain slurry weight and viscosity limits required.
  2. In case of cased auger earth pressure balance system, system shall be capable of adjustments required to maintain face stability for particular soil condition to be encountered. Monitor and continuously balance soil and ground water pressure to prevent loss of soil or uncontrolled ground water inflow.
    - a. In cased auger spoil transportation system, manage pressure at excavation face by controlling volume of spoil removal with respect to advance rate. Monitor speed of rotation of auger flight, and addition of water.
  3. Remote Control System. Provide MTBM which includes remote control system with following features:
    - a. Allows for operation of system without need for personnel to enter tunnel. Has display available to operator, at remote operation console, showing position of shield in relation to design reference together with other information such as face pressure, roll, pitch, steering attitude, valve positions, thrust force, and cutter head torque; rate of advance and installed length.
    - b. Integrates system of excavation and removal of spoil and its simultaneous replacement by pipe. As each pipe section is jacked forward, control system shall synchronize all of operational functions of system.
  4. Active Direction Control. Provide MTBM which includes active direction control system with following features:

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- a. Controls line and grade by guidance system that relates actual position of MTBM to design reference (e.g., by laser beam transmitted from jacking shaft along pipe to target mounted in shield).
  - b. Provides active steering information which shall be monitored and transmitted to operating console.
  - c. Provides positioning and operation information to operator on control console.
5. Use generator which is suitably insulated for noise ("hospital" type) in residential or commercial areas.
- G. Pipe Jacking Equipment. Provide pipe jacking system with following features:
1. Has main jacks mounted in jacking frame located in starting shaft.
  2. Has jacking frame which successively pushes string of connected pipes following tunneling excavation equipment towards receiving shaft.
  3. Has sufficient jacking capacity to push tunneling excavation equipment and string of pipe through ground. Incorporates intermediate jacking stations, if required.
  4. Has capacity at least 20 percent greater than calculated maximum jacking load.
  5. Develops uniform distribution of jacking forces on end of pipe by use of spreader rings and packing, measured by operating gauges.
  6. Provides and maintains pipe lubrication system at all times to lower friction developed on surface of pipe during jacking.
  7. Jack Thrust Reactions. Use reactions for pipe jacking that are adequate to support jacking pressure developed by main jacking system. Special care shall be taken when setting pipe guide rails in jacking shaft to ensure correctness of alignment, grade, and stability.
- H. Air Quality. Provide equipment to maintain proper air quality of manned tunnel operations during construction in accordance with OSHA requirements.
- I. Enclose lighting fixtures in watertight enclosures with suitable guards. Provide separate circuits for lighting, and other equipment.
- J. Electrical systems shall conform to requirements of National Electrical Code - NFPA70.

#### .04 PIPE-JACKED TUNNELING DATA

- A. Maintain shift logs of construction events and observations. AW Project Manager shall have access to all logs with regard to following information:
1. Location of boring machine face or shield by station and progress of tunnel drive during shift.
  2. Hours worked per shift on tunneling operations.
  3. Completed field forms, such as steering control logs, for checking line and grade of tunneling operation, showing achieved tolerance relative to design alignment.
  4. Maximum pipe jacking pressures per drive.

5. Location, elevation and brief soil descriptions of soil strata.
6. Ground water control operations and piezometric levels.
7. Observation of any lost ground or other ground movement.
8. Any unusual conditions or events.
9. Reasons for operational shutdown in event drive are halted.

#### .05 EXCAVATION AND JACKING OF PIPE

##### A. Tunnel Excavation.

1. Keep tunnel excavation within easements and rights-of-way indicated on Drawings and to lines and grades designated on Drawings.
2. Perform tunneling operations in manner that will minimize movement of ground in front of and surrounding tunnel. Prevent damage to structures and utilities above and in vicinity of tunneling operations.
3. Open-face excavations:
  - a. Keep face breasted or otherwise supported and prevent falls, excessive raveling, or erosion. Maintain standby face supports for immediate use when needed.
  - b. During shut-down periods, support face of excavation by positive means; no support shall rely solely on hydraulic pressure.
4. Closed-face excavation:
  - a. Carefully control volume of spoil removed. Advance rate and excavation rate to be compatible to avoid over excavation or loss of ground\_
  - b. When cutting head is withdrawn or is open for any purpose, keep excavated face supported and stabilized.
5. Excavated diameter should be minimum size to permit pipe installation by jacking with allowance for bentonite injection into annular space.
6. Whenever there is condition encountered which could endanger tunnel excavation or adjacent structures, operate without intermission including 24-hour working, weekends and holidays, until condition no longer exists.
7. Assume responsibility for damage due to settlement from any construction-induced activities.

##### B. Pipe Jacking

1. Cushion pipe joints as necessary to transmit jacking forces without damage to pipe or pipe joints.
2. Maintain envelope of bentonite slurry around exterior of pipe during jacking and excavation operation to reduce exterior friction and possibility of pipe seizing in place.
3. If pipe seizes up in place and elect to construct recovery access shaft, obtain approval from AW Project Manager. Coordinate traffic control measures and

utility adjustments as necessary prior to commencing work.

4. In event section of pipe is damaged during jacking operation, or joint failure occurs, as evidenced by inspection, visible ground water inflow or other observations, submit for approval his methods for repair or replacement of pipe.

C. Grouting. Grouting requirements are defined in Section 02431 - Tunnel Grout.

#### .06 CONTROL OF LINE AND GRADE

A. Construction Control.

1. Project Manager will establish baselines and benchmarks indicated on Drawings. Check baselines and benchmarks at beginning of Work and report any errors or discrepancies to AW Project Manager.
2. Use baselines and benchmarks established by AW Project Manager to establish and maintain construction control points, reference lines and grades for locating tunnel, sewer pipe, and structures.
3. Establish construction control points sufficiently far from work so as not to be affected by ground movement caused by pipe-jacked tunneling operations.

B. Bench Mark Movement. Ensure that if settlement of ground surface occurs during construction which affects accuracy of temporary benchmarks detect and report such movement and reestablish temporary bench marks. Locations of permanent local monumentation benchmarks are indicated on Drawings. Advise AW Project Manager of any settlement affecting permanent monumentation benchmarks.

C. Line and Grade.

1. Check and record survey control for tunnel against above-ground undisturbed reference at least once for each 250 feet of tunnel constructed.
2. Record exact position of MTBM or TBM or shield after each shove to ensure alignment is within specified tolerances. Make immediate correction to alignment before allowable tolerances are exceeded.
3. When excavation is off line or grade, make alignment corrections to avoid reverse grades in gravity sewers.
4. Acceptance criteria for sewer pipe shall be plus or minus 6 inches in horizontal alignment from theoretical at any point between manholes, including receiving end, and plus or minus 1-1/2 inches in elevation from theoretical.
5. Pipe installed outside tolerances and subsequently abandoned shall first be fully grouted.

#### .07 MONITORING

A. Instrumentation Monitoring. Instrumentation requirements are shown on Drawings. Instrumentation specified shall be accessible at all times to AW Project Manager. Readings shall be submitted promptly to AW Project Manager.

1. Install and maintain instrumentation system to monitor and detect movement of ground surface and adjacent structures. Establish vertical control points at distance from construction areas that avoids disturbance due to ground settlement.
  2. Installation of instrumentation shall not preclude AW Project Manager, through independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to construction work. Access shall be provided to work for such independent installations.
  3. Instruments shall be installed in accordance with Drawings and manufacturer's recommendations.
- B. Surface Settlement Monitoring
1. Establish monitoring points on all critical structures.
  2. Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.
  3. Ground surface elevations shall be recorded on centerline ahead of tunneling operations at minimum of 100-foot intervals or at least three locations per tunnel drive. For sewers greater than 60-inch diameter, also record similar data at approximately 20 feet each side of centerline. Settlement monitoring points must be clearly marked by studs or paint for ease of locating.
  4. Railroads. Monitor ground settlement of track subbase at centerline of each track.
  5. Utilities and Pipelines. Monitor ground settlement directly above and 10 feet before and after utility or pipeline intersection.
- C. Reading Frequency and Reporting. Submit to AW Project Manager, records of readings from various instruments and survey points.
1. Instrumentation monitoring results to be read at frequency specified and unless otherwise specified, shall be started prior to zone of active excavation reaching that point, and shall be continued until zone of active excavation has passed and until no further detectable movement occurs.
  2. Surface settlement monitoring readings shall be taken:
    - a. Prior to zone of active excavation reaching that point,
    - b. When tunnel face reaches monitoring point (in plan), and
    - c. When zone of active excavation has passed and no further movement is detected.
  3. All monitoring readings shall be submitted promptly to AW Project Manager.
  4. Immediately report to AW Project Manager any movement, cracking, or settlement which is detected.
  5. Following substantial completion but prior to final completion, make final survey of all monitoring points.

.08 DISPOSAL OF EXCESS MATERIAL

- A. Remove spoil materials off site in accordance with contract specification requirements.

.09 ACCEPTANCE TESTING

- A. Acceptance testing is to be carried out by methods described in Section 02533 - Acceptance Testing For Sanitary Sewers.

**END OF SECTION**



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STANDARD SPECIFICATION

AUGERING PIPE AND CONDUIT

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**SECTION 02447**

**AUGERING PIPE AND CONDUIT**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Installing water service pipe by methods of augering or casing by jacking and boring.
- B. Installing Telecommunication Conduit along or under Public Ways

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for augering pipe for water lines under this Section. Include payment in unit price for Section 02511 - Watermains.
  - 2. When open-cut construction is requested by Contractor for his convenience in areas designated for augering, and when approved in advance by Project Manager, such areas shall be paid for at Unit Price for Section 02511 - Watermains.
  - 3. Refer to Section - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 DEFINITIONS**

- A. Auger Method: Installation of steel casing by excavating soil at advancing end of casing and transporting spoil through casing by otherwise encased auger, while advancing casing by jacking at same rate as auger excavation progresses.
- B. Slurry Auger Method: Installation of casing or pipe by first drilling small diameter pilot hole from pit to pit, followed by removing excess soil and installing pipe or conduit by pull-back or jacking method.

**.04 REFERENCE STANDARDS**

- A. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- B. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
- C. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM D 790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

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**.05 REGULATORY REQUIREMENTS**

- A. Conform to State Department of Highways and Public Transportation for installations under state highways. AW will obtain required permits for State Highway crossings.
- B. Installations Under Railroads:
  - 1. Secure and comply with requirements of right-of-entry for crossing Railroad Company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
  - 2. Use auger method only.
  - 3. Damages due to delays caused by railroad requesting work to be done at hours which will not inconvenience the railroad will be at no additional cost to AW.
  - 4. Maintain equipment and excavations minimum 35-foot clearance from centerline of tracks.

**.06 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit product data for casing insulators, spacing of insulators for specific pipe and location on project.
- C. Prior to installation of pits obtain AW Project Manager's approval for pit locations, size, depth, and areas for storage, material, and spoil handling. Acceptance of AW Project Manager does not relieve Contractor from responsibility to obtain specified results.
- D. Show actual pit locations dimensioned on as-built drawings so that they can be identified in field.
- E. Submit copy of executed railroad company rights of entry to AW Project Manager.

**.07 CRITERIA FOR SELECTION OF MATERIAL**

- A. Contractor shall be responsible for selection of casing, pipe, and pipe joints to carry anticipated thrust of jacks or loads.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Piping and Fittings: As required by Specification or Drawings.
- B. Casings: Where shown on Drawings, in accordance with Section 02502 - Steel Pipe and Fittings.

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- C. Casing Spacers: Where casings are shown on Drawings, use casing spacer width 8 inches for pipe sizes 4 to 12 inches; 12 inches for pipe sizes 14 inches and larger. Wood skids or concrete "donuts" are not acceptable.
  - 1. For welded steel pipe 12 inches and smaller, use Pipeline Seal & Insulator Model PE, or approved equal.
  - 2. For other pipe materials, use Pipeline Seal & Insulator Model C8G-2 or approved equal for pipe sizes up to 12 inches.
  - 3. For all pipe sizes above 12 inches, use Pipeline Seal & Insulator Model C12G-2 or approved equal.
  - 4. Obtain approval for equal product in writing from AW Project Manager prior to bid.
  - 5. Use ISO-9002 registered casing spacer manufacturer or supplier. Submit copy of current certificate with submittal package.
- D. Casing End Seals: Provide Pipeline Seal and Insulator Model C, or approved equal.
- E. Casing Spacers (For Pipes Diameters 16 Inches or Greater): Bolt-on style with shell made of two sections of 14-gauge carbon steel, hot rolled, cleaned, and lined with PVC liner, 0.090 inch thick with Durometer A 85-90 overlapping edges to secure liner to spacer; deep embossed flanges for added strength; coated prior to installation of liner and runner with fusion-bonded PVC powder of 14 to 20 mils thickness; electroplated studs, nuts, and washers.
  - 1. Runners (For Pipe Diameters 16 Inches or Greater): Supported by 10-gauge carbon steel MIG risers welded to shell. Total length of weld beads shall be at least 50 percent of the length of the runner. Fill bolt holes with caulk or approved equal to provide a water-tight seal. Minimum requirements: Glass reinforced plastic conforming to the following tests:
    - a. Tensile Strength: ASTM D 638; 17,600 psi
    - b. Flexural Strength: ASTM D 790; 25,300 psi
    - c. Compression Strength: ASTM D 695; 18,000 psi
    - d. Deflection Temperature at 264 psi: ASTM D 648; 405 F
    - e. Polyethylene runners are not acceptable

**PART 3 EXECUTION****.01 LIMITS ON AUGER LENGTH WITHOUT CASING**

- A. Do not exceed 100 feet for length of auger hole without receiving pit.
- B. Do not exceed 75 feet for length of auger hole for PVC pipe 12 inches and less in diameter without receiving pit.
- C. Do not exceed 40 feet for length of auger hole for PVC pipe 14 inches to 24 inches in diameter without receiving pit.

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**.02 PREPARATION**

- A. Conform to applicable provisions of Section 02233 - Clearing and Grubbing.
- B. Utility Relocations: Relocate utility lines clear of pit and zone of potential significant settlement or other ground disturbance.
- C. Install casings as required by Drawings, in accordance with this Section.
- D. Install temporary solid plug at open end of water line to prevent contamination.

**.03 TRAFFIC CONTROL**

- A. Conform to applicable provisions of the contract documents.
- B. Secure right-of-entry for crossing Railroad Company's easement or right-of-way.
- C. During construction operations, furnish, and maintain barricades and lights to safeguard traffic and pedestrians, until such time as backfill has been completed and removed from site. Provide additional barricades and lights as directed by AW Project Manager.

**.04 PITS**

- A. Construct pits on segments of line and within right-of-way. Locate auger pits where there is minimum interference with traffic or access to property. Avoid locating pits close to storm drainage channels, ditches, storm water lines, culverts, or near potentially contaminated areas.
- B. Pit Size: Size pits to provide adequate room to meet operational requirements for auger construction as well as structures indicated on Drawings. Provide minimum 6-inch space between pipe and walls of auger pit. Maximum allowable width of pit shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full section of pipe and shall not exceed 25 feet.
- C. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes.
- D. Backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.
- E. Auger pits that are excavated and backfilled as part of open-cut water line construction shall be in accordance with Section 02317 - Excavation and Backfill for Utilities.
- F. Provide and properly maintain safety protection against traffic, and accidental or unauthorized entry. Provisions to include concrete traffic barriers or other suitable barrier around periphery of pit as appropriate. Fully cover and secure pits where no construction activity is in progress.
- G. Install sheeting, lining, shoring, and bracing required for protection of workmen and public.

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- H. Provide groundwater control and drainage from pits while work is in progress and until pit is properly backfilled.

**.05 AUGERING (BORING)**

- A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under Paragraph 3.04, Pits. Auger mechanically with use of pilot hole entire length of crossing and check for line and grade. Diameter of auger hole not to exceed pipe bell diameter plus 2 inches. Place excavated material outside working pit and dispose of as specified. Use water or other fluids in connection with boring operation only to lubricate cuttings; jetting is not permitted.
- B. In unconsolidated soil formations, gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication for subsequent removal of cuttings and installation of pipe.
- C. Depending on character of soil encountered during angering operation, conduct operations without interruption, insofar as practical, to prevent hole from collapsing or pipe from seizing up in hole before installation is complete.
- D. Allowable variation from line and grade shall be as specified under Paragraph 3.08, Jacking.
- E. Remove and replace pipe damaged in angering operations.

**.06 AUGERING OF CASING**

- A. Provide jacks, mounted on frame or against backstop, of capacity suitable for forcing excavating auger and casing through soil conditions to be encountered. Operate jacks so that even pressure is applied to casing.
- B. Provide steerable front section of casing to allow vertical grade adjustments. Provide water level or other means to allow monitoring of grade elevation of auger casing.
- C. Bentonite slurry may be used to lubricate casing during installation. Use of water to facilitate removal of spoil and to lubricate exterior casing is permitted; however, water jetting for excavation of soil is not allowed when jacking casing.
- D. Tolerances from lines and grades shown on Drawings for gravity sewer pipe installed in casing are plus or minus 6 inches in horizontal alignment, and plus or minus 1-1/2 inches in elevation.

**.07 FILLING ANNULAR SPACE**

- A. For installation of water line, block void space around pipe in augered hole with approximately 12 inches of packed clay or approved equal material to prevent bedding or backfill from entering void around pipe in angered hole when

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compacted. For pipe diameters 4 inches through 8 inches use minimum 1/2-cubic-foot clay; for pipe diameters 12 inches through 16 inches use minimum 3/4-cubic-foot clay.

**.08 JACKING**

- A. For all pits, end trenches, and other excavations relating to work required by specifications, dewater as required to provide safe working conditions.
- B. Wherever end trenches are cut into sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.
- C. Make up only one joint at time in pit or trench prior to jacking.
- D. Do not interfere with operation of railroad, street, highway, or other facility, nor to weaken or damage embankment or structure.
- E. Use heavy-duty jacks sized for forcing casing through embankment. Use appropriate jacking head, usually of timber, and bracing between jacks and jacking head and jacking frame or backstop. Apply jacking pressure uniformly around ring of casing. Set casing to be jacked on guides, properly braced together, to support section of casing and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of casing. Excavate embankment material just ahead of casing and remove material through casing. Force casing through embankment with jacks into excavated auger hole.
- F. Conform excavation for underside of casing to contour and grade of casing, for at least one third of circumference of casing. Provide clearance of not more than 2 inches for upper half of casing. Taper off upper clearance to zero at point where excavation conforms to contour of casing.
- G. Excavation may extend beyond end of casing depending on character of material, but shall not exceed 2 feet. Decrease advance excavation at direction of Project Manager, when character of material being excavated makes it desirable to keep advance excavation closer to end of casing.
- H. Jack casing from low or downstream end. Lateral or vertical variation in final position of casing from line and grade as shown on Drawings will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on Drawings.
- I. Use cutting edge of steel plate around head end of casing extending short distance beyond end of casing with inside angles or lugs to keep cutting edge from slipping back onto casing.
- J. Once jacking of casing is begun, carry on without interruption, insofar as practicable, to prevent casing from becoming firmly set in embankment.
- K. Remove and replace casing damaged in jacking operations.
- L. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of casing.

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- M. Grout annular space between casing and excavated hole when loss of embankment occurs or when clearance of 2 inches is exceeded.

.09 SPACER INSTALLATION

- A. There must be no inadvertent metallic contact between casing and carrier pipe. Place spacers to ensure that carrier pipe is adequately supported throughout length, particularly at ends, to offset settling, and possible electrical shorting unless otherwise approved by AW. Place end spacer within 6 inches of end of casing pipe, regardless of size of casing and carrier pipe or type of spacer used. Spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.
- B. Grade bottom of trench adjacent to each end of casing to provide firm, uniform, and continuous support for carrier pipe. When trench requires some backfill to establish final trench bottom grade, place backfill material in 6-inch lifts and compact to density of undisturbed soil.
- C. Install casing spacers in accordance with manufacturer's instructions. Take special care to ensure that sub-components are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.
- D. Seal annulus between carrier pipe and casing with casing end seals at each end of casing.
- E. Insulator Spacing:
1. Spacing shall be as shown on Drawing with maximum distance between spacers to be 10 feet for pipe sizes 4 to 14 inches and 8 feet for pipe sizes 16 to 30 inches.
  2. For ductile iron pipe or bell-and-spigot pipe, install spacers within one foot on each side of bell or flange and one in center of joint when 18- to 20-foot-long joints are used.
  3. If casing or carrier pipe is angled, bent, or dented, reduce spacing as directed by AW Project Manager. Provide casing with smooth, continuous interior surface.

.010 SETTLEMENT MONITORING

- A. Monitor ground surface elevation along length of augering operation. Locate and record settlement monitoring points with respect to construction baseline and elevations. Record elevations to accuracy of 0.01 feet for each monitoring point location.
1. Railroads: Track sub base at centerline of each track.
  2. Product pipelines: Directly above and 10 feet before and after pipeline intersection.
- B. Reading Frequency and Reporting. Take settlement survey readings:
- 1) Prior to auger excavation reaching point
  - 2) After auger reaches monitoring point in plan

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3) After grouting of ground supporting casing is complete

- C. Immediately report to AW Project Manager movement, cracking, or settlement which is detected.
- D. Following substantial completion but prior to final completion, make final survey of monitoring points.

.011 DISPOSAL OF EXCESS MATERIAL

- A. Conform to applicable provisions of Contract Documents.

**END OF SECTION**



**SECTION 02448****PIPE AND CASING AUGERING FOR SEWERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Installation of casing for sewer pipe by dry augering or slurry boring methods, together with installation of sewer pipe in casing.
- B. Installation of sewer pipe by slurry boring methods. Construction casing may be used at Contractor's option.

**1.02 MEASUREMENT AND PAYMENT****A. Unit Prices.**

1. Casing, including sewer pipe, installed by augering methods in mid-run of open cut segments where shown on Drawings, will be measured and paid by linear foot from end to end of casing. Casing may be installed, at Contractor's option, at locations other than shown on Drawings, at no additional cost to AW.
2. Sewer pipe installed by augering method in mid-run of open-cut segments where shown on Drawings, will be measured and paid by linear foot from end to end of augered section.
3. Pipe or casing segments installed by augering methods in locations other than mid-run of open cut segments and shown on Drawings, will be measured and paid by linear foot along centerline of completed sewer from centerline to centerline of manholes to ends of stubs or termination of pipe, and to inside face of lift stations and other structures.
4. Payment will include and be full compensation for labor, equipment, materials and supervision for excavation and construction of sewer, complete in place including disposal of excess materials, shoring, dewatering, utility adjustments, grouting, backfill, clean-up, and other related work necessary for construction as indicated on Drawings and specified in this Section.
5. Cost for pits and other excavations are included in unit price for pipe with or without casing.
6. Cost for trench safety systems for pits are included in unit price for pipe with or without casing.
7. Refer to Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

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## 1.03 DEFINITIONS

- A. Augering means either "dry augering" or "slurry augering".
- B. Dry augering is jacking casing while excavating soil at heading and transporting spoil back through casing by otherwise uncased auger.
- C. Slurry Auger Method: Installation of casing or pipe by first drilling small diameter pilot hole from shaft to shaft, followed by removing excess soil and installing pipe or conduit by pull back or jacking method.

## 1.04 REFERENCE STANDARDS

- A. American Railway Engineering and Maintenance-of Way Association (AREMA) Manual for Railway Engineering.
- B. American Association of State Highway and Transportation Officials (AASHTO).

## 1.05 REGULATORY REQUIREMENTS

- A. Conform to State Department of Highways and Public Transportation for installations under state highways. AW will obtain required permits for State Highway crossings.
- B. Installations under Railroads:
  - 1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
  - 2. Use dry auger method only.
  - 3. Damages due to delays caused by railroad requesting work to be done at hours which will not inconvenience the railroad will be at no additional cost to AW.
  - 4. Maintain minimum 35-foot clearance from centerline of tracks.

## 1.06 SUBMITTAL

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. For installation by augering, submit for review:
  - 1. Description of mechanized excavating equipment.
  - 2. Method of controlling line and grade.
  - 3. Grouting techniques to be used for filling annular void between sewer pipe and casing, and void between sewer pipe or casing and ground, including equipment, pumping and injection procedures, pressure grout types, and mixes.
  - 4. Locations and dimensions of pits.
  - 5. Pit design and construction drawings.
  - 6. Identification of casings required and paid under Contract and casings installed at

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Contractor's option.

7. Design of casings.
  8. Copy of railroad company permits and right-of-entry.
- C. Prepare auger pit and casing design submittals that are site specific. Have auger pit and casing design submittals signed and sealed by a qualified Professional Engineer registered in the State where the project is being completed
- D. Include in construction phase submittals:
1. Daily logs of augering and boring operations.
  2. Settlement monitoring data to meet requirements of paragraph 3.05, Settlement Monitoring.
  3. Submit daily logs and settlement monitoring data within 5 days after day of observation.

**1.07 CRITERIA FOR DETERMINING CASING INSTALLATION LOADS**

- A. Select and design casing pipe and pipe joints to carry thrust of jacks or loads due to pulling mechanism in combination with overburden, earth and hydrostatic loads. Select casings for dry augering to withstand action of auger without damage.
- B. Use Professional Engineer registered in the state where the project is being completed to determine design stresses, design deflections and factors of safety for design of casing. Present such determination as part of design submittal. Apply the following maximum casing pipe stresses and deflections to casings shown on Drawings:
1. Design stress in pipe wall: 50 percent of minimum yield point of steel or 18,000 psi, whichever is less, when subjected to applicable loading conditions.
  2. Wall thickness: Maximum allowable deflection which does not exceed 3 percent of nominal casing diameter.
- C. Use Cooper E-80 locomotive loading distributions as criteria for railroad crossings in accordance with AREMA specifications for culverts. In design, account for additive loadings due to multiple tracks.
- D. Use H-20 vehicle loading distributions as criteria for truck loading in accordance with AASHTO.
- E. When not specifically indicated on Drawings, select casing diameter to permit practical installation (including skids when applicable) and grouting.

**PART 2 PRODUCTS****2.01 MATERIAL**

- A. Provide casing pipe which is straight, circular in section, uncoated, welded steel pipe, in accordance with Section 02502 - Steel Pipe and Fittings.

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- B. Provide sewer pipe in accordance with Section 02531 - Gravity Sanitary Sewers. Do not use high density polyethylene pipe for augering.
- C. Provide restrained joint sewer pipe when installing sewer pipe in slurry bored holes by pullback method.
- D. Supply grout as specified.

**PART 3 EXECUTION****3.01 LOCATION AND SIZE OF AUGER PITS**

- A. Show location of auger pits on auger pit construction drawings. Locate auger pits for slurry boring so that distance between pits is no greater than 80 feet; and for dry augering not more than 120 feet apart.
- B. Locate auger pits and associated work areas to avoid blocking driveways and cross streets and to minimize disruption to business and commercial interests. Avoid auger pit locations near areas identified as potentially contaminated.
- C. Make size adequate for construction of structures indicated on Drawings. Provide adequate room to meet Contractor's operational requirements for augering.
- D. Provide portable concrete traffic barrier around periphery of pit, meeting applicable safety standards. Properly maintain barrier throughout period pit remains open. Angle traffic barriers in direction of lane flow; do not place barriers perpendicular to on-coming traffic.
- E. Provide full cover or other security fencing for each access pit in which there is no construction activity or which is unattended by Contractor's personnel.

**3.02 DRY AUGERING OF CASING**

- A. Provide jacks, mounted on frame or against backstop, of capacity suitable for forcing excavating auger and casing through soil conditions to be encountered. Operate jacks so that even pressure is applied to casing.
- B. Provide steerable front section of casing to allow vertical grade adjustments. Provide water level or other means to allow monitoring of grade elevation of auger casing.
- C. Bentonite slurry may be used to lubricate casing during installation. Use of water to facilitate removal of spoil is permitted; however, water jetting for excavation of soil is not allowed when jacking casing.
- D. Tolerances from lines and grades shown on Drawings for gravity sewer pipe installed in casing are plus or minus 6 inches in horizontal alignment, and plus or minus 1-1/2 inches in elevation.

### 3.03 SLURRY BORING OF CASING OR PIPE

- A. Drill small diameter pilot hole and check for line and grade at receiving end. Redrill pilot hole when bored pipe does not meet specified tolerances.
- B. Using pilot hole as guide bore larger diameter hole of sufficient size for pipe or casing installation. Water jetting is not permitted.
- C. Bentonite slurry may be used to maintain stable hole and furnish lubrication for pipe or casing installation.
- D. Tolerances from lines and grades shown on Drawings for installed sewer pipe are plus or minus 6 inches in horizontal alignment and plus or minus 1-1/2 inches in elevation.
- E. Completely fill annular space between sewer pipe and surrounding soil or casing with grout, without displacing pipe during grouting operation.

### 3.04 SEWER PIPE IN CASING

- A. Grout annular void between sewer pipe and casing from end to end of casing. Block and brace sewer pipe to prevent movement during grout placement and to maintain specified line and grade.

### 3.05 SETTLEMENT MONITORING

- A. Monitor ground surface elevation along length of augering operation. Locate and record settlement monitoring points with respect to construction baseline and elevations. Record elevations to accuracy of 0.01 feet for each monitoring point location. Establish monitoring points at locations and by methods that protect them from damage by construction operations, tampering, or other external influences. As minimum, locate survey points as follows:
  - 1. For road crossings: Centerline and each shoulder
  - 2. Railroads: Track subbase at centerline of each track
  - 3. Utilities and Pipelines: Directly above and 10 feet before and after utility or pipeline intersection
  - 4. Long bores under improved areas such as pavements: Ground surface elevations must be recorded on centerline ahead of augering operations at locations not to exceed 50 feet apart (including points located for roads, railroads, utilities, and pipelines), or at least three locations per augering drive
- B. Reading Frequency and Reporting. Take settlement survey readings:
  - 1. Prior to auger excavation reaching point
  - 2. After auger reaches monitoring point in plan
  - 3. After grouting of ground supporting pipe or casing is complete
- C. Immediately report to AW Project Manager movement, cracking, or settlement which is detected.

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- D. Following substantial completion but prior to final completion, make final survey of monitoring points.

3.06 DISPOSAL OF EXCESS MAIERIAL

- A. Remove and dispose of spoil from job site in accordance with contract specification requirements.

3.07 LEAKAGE TESTING

- A. Test sanitary sewers for leakage by low pressure air methods in accordance with Section 02533 - Acceptance Testing for Sanitary Sewer.

**END OF SECTION**

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**DUCTILE IRON PIPE AND FITTINGS**

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**SECTION 02501**

**DUCTILE IRON PIPE AND FITTINGS**

**PART1      GENERAL**

1.01    SECTION INCLUDES

- A.     Ductile iron pipe and fittings for watermain, wastewater force mains, gravity sanitary sewers, and storm sewers.
- B.     Related Sections:
  - 1.    Section 02511 - Watermain
  - 2.    Section 02531 - Gravity Sanitary Sewers
  - 3.    Section 02532 - Sanitary Sewage Force Mains

1.02    REFERENCES

- A.     ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.
- B.     ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.
- C.     ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D.     ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
- E.     ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.
- F.     ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.
- G.     ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.
- H.     ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.

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- I. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- J. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.
- K. ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.
- L. ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.
- M. AWWA C 102 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- N. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.
- O. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- P. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.
- Q. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
- R. American Association of State Highway Transportation Officials (AASHTO).

**1.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. For pipes 16 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in the State where the project is being completed showing the following:
  - 1. Manufacturer's pipe design calculations.
  - 2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Contracting Officer. Provide final approved lay schedule on CD-ROM in Adobe portable document format (\*.PDF).
  - 3. Calculations and limits of thrust restraint.
  - 4. Class and length of joint.



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- C. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.
- D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.
- E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

**PART 2 PRODUCTS****2.01 DUCTILE IRON PIPE**

- A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for watermains and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe.
- B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.
- C. Modify pipe for cathodic protection in accordance with Cathodic Protection for Pipelines. In lieu of furnishing ductile iron pipe with cathodic protection system, furnish ductile iron pipe with polyethylene encasement, provided the following criteria is met:
  - 1. Provide minimum thickness class.
  - 2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.
  - 3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.05 D.1.
  - 4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).
- D. For use of pressure class pipe for watermains, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and

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tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = 100 psi.
  2. Hydrostatic field test pressure = 150 psi.
  3. Maximum pressure due to surge = 150 psi.
  4. Minimum Pressure due to surge = 5 psi.
  5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.
  6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.
  7. Unit weight of fill  $\geq$  120 pcf.
  8. Deflection lag factor (DI) = 1.2.
  9. Bedding constant (K) = 0.1.
  10. Moment coefficient = 0.16.
  11. Fully saturated soil conditions  $hw=h$ =depth of cover above top of pipe.
- E. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.
- F. Pipe Manufacturer for large diameter watermain: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

| Line Diameter  | Required Bends*                              |
|--|--|
| 20 and 24 inches   | Four 45° bends per 5,000 LF of water line    |
| >24 inches   | Four 22.5° bends per 10,000 LF of water line |
| *Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e., Two 22 ½ ° bends are equivalent to one 45° bend) and will be counted as one fitting. |  |

- G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by AWS Project Manager.

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- H. Clearly mark pipe section to show location and thickness/pressure class color coded.

**2.02 JOINTS**

- A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.
- B. Where required by Drawings, provide approved restrained joints for buried service.
- C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
- D. Provide for restrained joints designed to meet test pressures required under Hydrostatic Testing of Pipelines or Section 02532 - Sanitary Sewer Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.
- E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.
- F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Contracting Officer. When other methods are deemed satisfactory, install at no additional cost to Government.

**2.03 GASKETS**

- A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

**2.04 FITTINGS**

- A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an of size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.
- B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

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- C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
- D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.
- E. Ductile Iron Compact Fittings for Water lines: ANSI A 21.53; 4 inch through 12 inch diameter fusion bonded epoxy-lined or cement mortar lining.

## 2.05 COATINGS AND LININGS

- A. Watermain Interiors: ANSI A21.4, cement lined with seal coat; comply with NSF 61.
- B. Sanitary Sewer and Force Main Interiors:
  - 1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
  - 2. Liner thickness: Nominal 40 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.
  - 3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
  - 4. Acceptable Lining Materials:
    - a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
    - b. Ceramic Epoxy - Protecto 401.
- C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.
- D. Exterior:
  - 1. Watermains
    - a. Above Ground (or Exposed): Conform to requirements of Section 02502 - Steel Pipe and Fittings, Paragraph 2.03.
    - b. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.05E.

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2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.
- E. Polyethylene Wrap: For buried pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02528 - Polyethylene Wrap.
- F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.
- G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the documents or as indicated by Ft. Sill DPW Environmental office.
- H. For water lines cathodically protected, supply ductile iron pipe with either tape coatings or some other bonded dielectric coating.

**2.06 MANUFACTURERS**

- A. Use pre-approved manufacturers listed in approved products of the contract document.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Conform to installation requirements of Sections 02511 - Watermains, 02531 - Gravity Sanitary Sewers, and 02532 - Sanitary Sewer Force Mains, except as modified in this Section.
- B. Install in accordance with AWWA C 600 and manufacturer's recommendations.
- C. Install all ductile iron pipe in double polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.
- D. Holiday Testing.
  1. Polyurethane: Polyurethane Coatings for Steel or Ductile Iron Pipe.
  2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

- A. Polyurethane: Provide Polyurethane Coatings for Steel or Ductile Iron Pipe.

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- B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION

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**COPPER TUBING**

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**SECTION 02503**

**COPPER TUBING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Copper tubing for water service lines.

1.02 REFERENCES

- A. ASTM B 88 - Standard Specification for Seamless Copper Water Tube.
- B. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certified test results of ASTM B 88.
- C. Submit manufacturer's testing certification that copper tubing conforms to requirements of ASTM B 88. Number of samples for testing of each size of tubing is modified as follows:
  - 1. For each 7500 feet of tubing: 1 sample
  - 2. For each set of tubing less than 7500 feet: 1 sample

**PART 2 PRODUCTS**

2.01 MATERIALS

- A. Provide Type K annealed, seamless, copper tubing, 3/8 inch to 2 inch in diameter conforming to requirements of ASTM B 88.
- B. Provide 3/8-inch and 1-inch tubing in coils of minimum 60 feet in length, and 1 1/2 inch and 2-inch tubing in coils 40 feet in length.
- C. Provide tubing manufactured in United States of America. Tubing shall be inspected and tested by a certified laboratory approved by Contracting Officer at point of manufacture or locally. Furnish tubing, at no additional cost to designated testing laboratory along with mill compliance certificates.

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- D. Provide flared or compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C 800.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Conform to installation requirements of Section 02512 - Water Tap and Service Line Installation, except as modified in this Section.

**3.02 JOINTS**

- A. Minimum joint spacing for 3/4-inch and 1-inch tubing shall be 60 feet and for 1 1/2 inch and 2-inch tubing shall be 40 feet.
- B. Cut copper tubing squarely by using cutting tools designed specifically for purpose and avoid procedures that cause pipe to bend or pipe walls to flatten.
- C. After tubing has been cut, but before flaring, use reamer to remove inside rolled lip from tubing. Expand flared ends by use of flaring tool using care to avoid splitting, crimping, or over stressing metal. Provide at least 10 inches of straight pipe adjacent to fittings.
- D. When compression fittings are used, cut copper tubing squarely prior to insertion into fitting. Assemble in accordance with manufacturer's recommended procedure.

**3.03 BENDS**

- A. Bend tubing by using appropriate sized bending tool. No kinks, dents, flats, or crimps shall be permitted. Cut out and replace damaged section. Install no bends with radius smaller than radius of coil of tubing as packaged by manufacturer. Copper tubing shipped in straight lengths conforms to the following:
1. For 2-inch diameter: Maximum of one 45-degree bend per 4-foot section.
  2. For 1 1/2-inch diameter: Maximum of one 45-degree bend per 3-foot section.

END OF SECTION



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**HIGH DENSITY POLYETHYLENE  
(HDPE) SOLID AND PROFILE WALL PIPE**

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**SECTION 02505**

**HIGH DENSITY POLYETHYLENE (HDPE)  
SOLID AND PROFILE WALL PIPE**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
- B. High density polyethylene (HDPE) pipe for sanitary sewer forcemains, including fittings.
- C. High density polyethylene (HDPE) pipe for storm sewers culverts.

**.02 REFERENCES**

- A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18" - 48" diameter.
- B. AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.
- C. AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.
- D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.
- E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- F. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.
- G. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyethylene Pipe and Fittings.
- H. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- I. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

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- M. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.
- N. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

**.04 QUALITY CONTROL**

- A. Provide manufacturer's certificate of conformance to Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. Contracting Officer reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
  - 1. Manufacturer's Notification: Should Contracting Officer wish to witness manufacture of specific pipes, manufacturer shall provide Contracting Officer with minimum three weeks notice of when and where production of those specific pipes will take place.
  - 2. Failure to Inspect. Approval of products or tests is not implied by Contracting Officer's decision not to inspect manufacturing, testing, or finished pipes.

**.05 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

**PART 2 PRODUCTS**

**.01 GENERAL**

- A. For sewer pipe provide HDPE pipe as follows:

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1. NEW CONSTRUCTION PIPE PRODUCTS GRAVITY SANITARY SEWER DIRECT BURY

| Installation Spec No. | Generic Name              | Trade Name or Manufacturer  | ASTM  | SDR (Numeric Maximum) | Pipe Stiffness (Numeric Minimum) | Size Range                        |
|-----------------------|---------------------------|---|-------|-----------------------|----------------------------------|-----------------------------------|
| 02550                 | Solid Wall Poly           | Chevron Plexco<br>Quail Poly Pipe<br>AmeriFlow by NAPCO<br>AmeriFlow by KWH | F-714 | DR 21                 | 46                               | 8" – 48"<br>3" – 12"<br>14" – 63" |
| 02550                 | Polyethylene Profile Wall | Spirolite   | F-894 | n/a                   | 46                               | 18" – 120"                        |

2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

| Installation Spec No. | Generic Name              | Trade Name or Manufacturer  | ASTM  | SDR (Numeric Maximum) | Pipe Stiffness (Numeric Minimum) | Size Range                        |
|-----------------------|---------------------------|---|-------|-----------------------|----------------------------------|-----------------------------------|
| 02550                 | Solid Wall Poly           | Chevron Plexco<br>Quail Poly Pipe<br>AmeriFlow by NAPCO<br>AmeriFlow by KWH | F-714 | DR 21                 | 46                               | 8" – 48"<br>3" – 12"<br>14" – 63" |
| 02550                 | Polyethylene Profile Wall | Spirolite   | F-894 | n/a                   | 46                               | 18" – 120"                        |

B. For Residential Driveway Culverts provide HDPE as follows:

1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
2. Sure-Lok F477 by Hancor, Inc.
3. Or approved equal.

C. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.

D. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.

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- E. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.
- F. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
  - 1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged.
  - 2. Exterior Bell and Spigot. Bell shall be fully welded to exterior of pipe and overlap spigot end so that flow lines and ends match when fully engaged.
- G. Jointing:
  - 1. Gaskets:
    - a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both,
    - b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

| CONTAMINANT                  | GASKET MATERIAL REQUIRED            |
|------------------------------|-------------------------------------|
| Petroleum (diesel, gasoline) | Nitrite Rubber                      |
| Other Contaminants           | As recommended by pipe manufacturer |

- 2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

## .02 MATERIALS FOR SANITARY SEWER

- A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.
- B. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in

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intended use. Examples of suitable material include polyethylene and polypropylene.

**.03 MATERIALS FOR RESIDENTIAL DRIVEWAY CULVERTS**

- A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.
- B. Types: CPP shall meet one or both of following:
  - 1. Type S: Outer corrugated wall with smooth inner liner.
  - 2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.
- C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

**.04 TEST METHODS FOR SANITARY SEWER**

- A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Contracting Officer. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.
- C. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.
- D. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

**.05 TEST METHODS FOR RESIDENTIAL DRIVEWAY CULVERTS**

- A. Pipe stiffness at 5 percent deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.
- B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

**.06 MARKING**

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- A. Mark each standard and random length of pipe in compliance with these Specifications with following information:
1. Pipe size.
  2. Pipe class.
  3. Production code.
  4. Material designation.

**PART 3 EXECUTION**

**.01 INSTALLATION**

- A. Conform to requirements of following Sections:
1. Section 02531 - Gravity Sanitary Sewers.
  2. Section 02532 - Sanitary Sewage Force Mains.
  3. Section 02533 - Acceptance Testing for Sanitary Sewers.
- B. Install pipe in accordance with the manufacturers recommended installation procedures.
- C. HDPE pipe is not approved in applications requiring auguring of pipe.
- D. Bedding and backfill: Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

**END OF SECTION**

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**POLYVINYL CHLORIDE PIPE**

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**SECTION 02506**

**POLYVINYL CHLORIDE PIPE**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 16 inches.
- B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.
- C. Polyvinyl chloride pressure pipe for gravity sewers and forcemains in nominal diameters 4 inches through 16 inches.
- D. Related Sections:
  - 1. Section 02511 -Watermains
  - 2. Section 02531 - Gravity Sanitary Sewers
  - 3. Section 02532 - Sanitary Sewer Forcemains

**.02 REFERENCES**

- A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
- B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
- C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

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- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
- P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
- R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
- S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.
- T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

**.04 QUALITY CONTROL**

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.



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- B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Contracting Officer for review. Cost of testing paid by Contractor.

**PART 2 PRODUCTS****.01 MATERIAL**

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.
- C. PVC Restrained Pipe: Must be listed on American Water's (AW's) current Product Approval List.
  - 1. Pipe Material:
    - a. DR 18: For restrained joints where shown on Drawings.
    - b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.
- D. Water Service.
  - 1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to State Fire Insurance Committee for use in fire protection lines.
  - 2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).
- E. Gaskets:
  - 1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
  - 2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
  - 3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber,

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with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

- F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- G. Do not use PVC in potentially or known contaminated areas.
- H. Do not use PVC in areas exposed to direct sunlight.

**.02 WATER SERVICE PIPE**

- A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.
- B. Pipe 14 inch through 16 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.
- C. Provide Polyvinyl Chloride Pipe from approved manufacturers.
- D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Contracting Officer.
- E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

**.03 GRAVITY SEWER PIPE**

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

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| WALL<br>CONSTRUCTION | MANUFACTURER   | ASTM<br>DESIGNATION | SDR (Max)<br>STIFFNESS<br>(MIN.) | DIAMETER<br>SIZE RANGE |
|----------------------|--|---------------------|----------------------------------|------------------------|
| Solid                | 7-M Pipe<br>CertainTeed<br>Diamond<br>Uponor ETI<br>North American | D3034               | SDR 26 IPS 115                   | 6" to 10"              |
|                      |  | D3034               | SDR 35 IPS 46                    | 12" & 15"              |
|                      |  | F679                | SDR 35 I PS 46                   | 18" to 27"             |
|                      |  | AWWA C900           | DR 18 /NIA                       | 4" to 12"              |
|                      |  | AWWA C909           | DR 181 NIA                       | 4" to 12"              |
|                      |  | AWWA C905           | DR 18 /NIA                       | 14" to 16"             |
| Truss (Gasketed)     | Contech  | D2680               | N/A /200 psi                     | 8" to 15"              |
| Profile              | Contech A-2000   | F949                | N/A 146 psi                      | 12" to 36"             |
|                      | Contech A-2026   | F949                | N/A 1115 psi                     | 8" to 10"              |
|                      | ETI, Ultra-Rib   | F794                | N/A 146 psi                      | 5" to 30"              |
|                      | ETI, Ultra-Cory  | F794                | N/A 146 psi                      | 24" to 36"             |

- B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Contracting Officer. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative

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humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

- G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (150 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (300 mm) in length.
- H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

**.04 SANITARY SEWER FORCE MAIN PIPE**

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Section 02532 - Sanitary Sewer Force Mains.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide approved ductile iron fittings as per Section 02501 - Ductile Iron Pipe and Fittings, Paragraph 2.04, except furnish fittings with one of following approved internal linings:
  - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
  - 2. Nominal 40 mils (35 mils minimum) polyurethane
  - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
  - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 02528 - Polyethylene Wrap.

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- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

**.05 BENDS AND FITTINGS FOR PVC PRESSURE PIPE**

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 psi, may be provided for up to 12 inches in diameter (water or sanitary).
- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

**PART 3 EXECUTION****.01 PROTECTION**

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

**.02 INSTALLATION**

- A. Conform to requirements of Section 02511 - Watermains, Section 02531 - Gravity Sanitary Sewers, and Section 02532 - Sanitary Sewer Forcemains, as applicable.
- B. Install PVC pipe in accordance with Section 02317 - Excavation and Backfill for Utilities, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
  - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
  - 2. Water service pipe 16 inches in diameter and larger 5 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

**.03 PVC RESTRAINED MECHANISM**

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.

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- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
  - 1. Perform by workers certified by manufacturer.
  - 2. Use a PVC pipe cutter and provide square ends.
  - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

**END OF SECTION**

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WATERMAINS****SECTION 02511****WATERMAINS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Installation of watermains.
- B. Specifications identify requirements for both small diameter watermains and large diameter watermains. When specifications for large diameter watermains differ from those for small diameter watermains, large diameter specifications will govern for large diameter pipe.

**1.02 REFERENCES**

- A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- B. ANSI/NSF Standard 61 - Drinking Water System -Health Components.
- C. ASTM A 36 - Standard Specification for Carbon Structural Steel
- D. ASTM A 536 - Standard Specification for Ductile Iron Castings
- E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes.
- G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar.
- I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.
- J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination
- K. ASTM E 709 - Standard Guide for Magnetic Particle Examination
- L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
- M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

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- N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.

**1.03 SUBMITTALS**

- A. Conform to the Section of Section 01300 - Submittal Procedures.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Construction Photographs to be taken prior to commencement of construction with both the Contractor and the Contracting Officer to be present.
- D. Submit videotapes conforming to requirements of Construction Videotapes, if applicable.
- E. Submit proper notification transmittal number prior to beginning excavation.
- F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
1. Disinfection; not to exceed 4,000 linear feet per section.
  2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
  3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

**PART 2 PRODUCTS****2.01 PIPE MATERIALS**

- A. Install watermain pipe materials, which conform to following:
1. Section 02501 - Ductile Iron Pipe and Fittings.
  2. Section 02506 - Polyvinyl Chloride Pipe. (PVC)
- B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
- C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.



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- D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

**2.02 RESTRAINED PIPE JOINTS**

- A. Ductile-Iron Pipe (DI): Refer to Section 02501 - Ductile Iron Pipe and Fittings.
- B. PVC Pipe: Refer to Section 02506 - Polyvinyl Chloride Pipe (PVC). Perform hydrostatic testing in accordance with ASTM F 1674.
- C. Restrained Joints where required on DI and PVC pipe:
  - 1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
  - 2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

**PART 3 EXECUTION****3.01 PREPARATION**

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Lay pipe to lines and grades shown on Drawings.
- D. Confirm that eight (8) feet minimum separation from gravity sanitary sewers and manholes or separation of four (4) feet minimum from forcemains as specified in this Section in all directions unless special design is provided on Drawings.
- E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Contracting Officer before proceeding with construction.
- F. Inform Contracting Officer if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Contracting Officer
- G. Contractor shall coordinate with Ft. Sill DPW for operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers. Ft. Sill DPW shall coordinate with AW on-site field staff for operation involving water line/valve opening or closing.

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- H. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's (AWWA) publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.
- I. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.
- J. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Contracting Officer.

**3.02 HANDLING, CLEANING AND INSPECTION****A. Handling:**

- 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
- 2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
- 3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
- 4. For large diameter watermain pipes, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
- 5. Use precautions to prevent injury to pipe, protective linings and coatings.
  - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
  - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
  - c. Do not lift pipe using hooks at each end of pipe.
  - d. Do not place debris, tools, clothing, or other materials on pipe.
- 6. Repair damage to pipe or protective lining and coating before final acceptance.
- 7. For cement mortar line permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe

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8. Reject pipe with visible cracks and remove from project site.

- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

### 3.03 EARTHWORK

- A. Conform to applicable provisions of Section 02317 - Excavation and Backfilling for Utilities.
- B. Bedding: Use bedding materials in conformance with Section 02320 - Utility Backfill Materials.
- C. Backfill: Use bank run sand or earth or native soil as specified in Section 02320 - Utility Backfill Materials. Backfill excavated areas in the same day they were excavated for paved streets. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Water tamping is not allowed.
- E. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

### 3.04 PIPE CUTTING

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Contracting Officer. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

### 3.05 PIPING INSTALLATION

- A. General Requirements:
  - 1. Lay pipe in sub grade free of water.
  - 2. Make adjustments of pipe to line and grade by scraping away sub grade or filling in with granular material.

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3. Properly form bedding to fully support bell without wedging or blocking up bell.
4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe.

Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

- B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Contracting Officer prior to skipping any portion of Work.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.
- D. Perform Critical Location as shown on Drawings. Refer to Section 02317 - Excavation and Backfill for Utilities for additional requirements at critical locations.
- E. For tie-ins to existing watermains, provide necessary material on hand to facilitate connection prior to shutting down existing watermain. Provide Contracting Officer a minimum of two weeks notice prior to shutting down existing watermain.

**3.06 JOINTS AND JOINTING**

- A. Rubber Gasketed Bell-and-Spigot Joints for PVC, Steel, and DIP:
  1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
  2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
  3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
  4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage

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and replace if necessary before remaking joint.

5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
  - a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
  - b. Do not include passive resistance of soil in thrust restraint calculations.
6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by AW Project Manager.

B. Flanged Joints where required on Ductile Iron Pipe:

1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Denso petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.
4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with AW's "Approved Products List." (We need this list to include in RFP package.)
5. PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.

C. Restrained Joints

1. For existing watermain less than 16 inches in diameter, affected by new watermain construction, restrain existing pipe joints with concrete thrust blocks. For all new watermain construction, use thrust restraint glands for the pipe lengths either side of the mechanical joint fittings as shown on the Drawings and or as specified.
2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths.

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These lengths are based on deflections indicated and on use of pre-stressed concrete pressure pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer for the State in which the project is being constructed, for review by Contracting Officer. Make adjustments in thrust restraint lengths at no additional cost to Government.

3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
5. Installation.
  - a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
  - b. Examine and clean mechanism; remove dirt, debris and other foreign material.
  - c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
  - d. Verify gasket is evenly seated.
  - e. Do not over stab pipe into mechanism.
6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
7. Place 2500 psi concrete conforming to Concrete for Utility Construction, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of new watermain. Test may be made 2 days after completion of blocking if Type II cement is used.
- D. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Contracting Officer. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.
  1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.

2. If deflection exceeds that specified but is less than 5 percent, repair entire

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deflected pipe section such that maximum deflection allowed is not exceeded.

3. If deflection is equal to or exceeds 5% from that specified, remove entire portion of deflected pipe section and install new pipe.
4. Replace, repair, or reapply coatings and linings as required.
5. Assessment of deflection may be measured by Contracting Officer at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.

**3.07 SECURING, SUPPORTING AND ANCHORING**

- A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and Subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

**3.08 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE**

- A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.
- B. Conform to requirements of Section 02528 - Polyethylene Wrap.

**3.09 CLEANUP AND RESTORATION**

- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old watermains, backfill and surface restoration.
- B. Unless otherwise approved by Contracting Officer, comply with the following;

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1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
  2. No later than three days after completing disinfection preparatory work, submit to Contracting Officer appropriate request for disinfection.
  3. If Contractor fails to perform initial disinfection of lines in accordance with Section 2514 - Disinfection of Water Lines, within seven days from submission of appropriate request, and if approved by Contracting Officer, pipe laying operations may continue beyond approved limits until the AWS responds.
  4. Immediately after transfer of services, begin abandonment of old watermains and site restoration.
  5. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Site Restoration contract specifications. Allow access to adjacent construction sites. Coordinate with Contracting Officer and adjacent contractors.
  6. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.
- C. For large diameter watermains, do not install more than 2,000 linear feet of watermain, without the previous 2,000 linear feet being restored. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet.

### 3.10 TRACING WIRE

- A. Tracing wire is to be installed on all new watermain pipe for future locating purposes regardless of the watermain pipe material. A solid #12 gauge, TWU copper wire is to be installed along the top of the pipe, taped to the pipe at 20-foot intervals. All costs for the supply and installation of the tracing wire shall be included as part of the unit price bid for watermains.
- B. The wire is to be installed between each valve and/or the end of the new watermain. Joints in the wire between valves are not permitted. At each valve (including fire hydrant isolation valves), a loop of wire is to be brought up the outside of the valve box and looped inside the box through a hole drilled 2 inches below the bottom of the lid as per tracer wire installation drawing.
- C. The American Water Project Engineer may test the tracing wire for conductivity. If the tracing wire is not continuous the contractor shall, at his own expense, replace or repair the wire.

### 3.11 WATERMAIN WARNING TAPE



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- A. Watermain “Underground Warning Tape” is to be installed for all new watermain pipe installations for the purpose of protecting the watermain during future excavation in the vicinity regardless of the watermain pipe material. The Warning Tape as a minimum shall be 3 inches wide, 3.5-mil polyethylene, “blue” in color, with the wording “CAUTION – BURIED WATERLINE BELOW.” All costs for the supply and installation of the underground watermain warning tape shall be included as part of the unit price bid for watermains.
- B. The “Underground Warning Tape” is to be installed below the granular road base materials in order to provide a final depth of bury for the tape as being approximately 15 inches below the final road surface. Splice/over laps in the tape to be a minimum of 12 inches in length.

**3.12 CLEANING PIPING SYSTEMS**

- A. Remove construction debris or foreign material and thoroughly swab clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. Contracting Officer must inspect watermain for cleanliness prior to filling.

**3.13 DISINFECTION OF WATERMAINS**

- A. Conform to requirements of Section 02514 - Disinfection of Watermains.

**3.14 FIELD HYDROSTATIC TESTS**

- A. Conform to requirements of Section 02515 - Hydrostatic Testing of Pipelines.

END OF SECTION

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LINE INSTALLATION**

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**SECTION 02512**

**WATER TAP AND SERVICE LINE INSTALLATION**

**PART1 GENERAL**

1.01 SECTION INCLUDES

- A. Tapping existing and or new watermains and furnishing and installing new service lines for water.
- B. Relocation of existing small water meters.
- C. Specifications identify requirements for small-diameter (less than or equal to 20 inches) watermains.

1.02 REFERENCES

- A. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.
- B. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution.

1.03 DEFINITIONS

- A. Short Side Connection Service Line: Installation of a new corporation main stop and connecting a new length of proposed water service piping between the new proposed watermain to the existing water service piping connected to the existing watermain located on same side of street as to where the new watermain is being constructed.
- B. Long Side Connection Service Line: Installation of a new corporation main stop, and connection to the existing water service piping that provides water service to the buildings on the opposite side (long side) of the street from of the centerline of the proposed new watermain..

**PART 2 PRODUCTS**

2.01 MATERIALS

- A. Copper Tubing: In accordance with Section 02503 - Copper Tubing. Where existing service piping is determined to be 'Copper' new service piping shall be 'Copper Tubing' to match existing.
- B. Corporation Main Stops: AWWA C 800 as modified in this Section:

- 1. Inlet End: AWWA standard thread.

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2. Valve Body: Tapered plug type, O-ring seat ball type, or rubber seat ball type.
3. Outlet End: Flared-copper connection for use with Type K, soft copper or compression type fitting.
- C. Provide taps for water line types and sizes in accordance with pipe tapping schedule located at end of this Section.
- D. Dual Strap Saddles: Red brass body and straps; ductile-iron; vinyl-coated body and straps; or ductile-iron, vinyl-coated body and stainless-steel straps.
- E. Taps for PVC Watermains: Use dual-strap or single, wide-band strap saddles which provide full support around circumference of pipe and bearing area of sufficient width along axis of pipe, 2 inches minimum, ensuring that pipe will not be distorted when saddle is tightened. Provide approved stainless-steel tapping saddle with AWWA standard thread.
- F. Taps for Steel Pipe: Not allowed, unless specifically approved by Contracting Officer. Use saddle only when tap is approved on steel pipe.
- G. Curb Stops and Brass Fittings: AWWA C 800 as modified in this Section.
  1. Inlet End: Flared copper connection or compression-type fitting
  2. Valve Body: Straight-through or angled, meter-stop design equipped with following:
    - a. O-ring seal straight plug type.
    - b. Rubber seat ball type.
  3. Outlet End: Female, iron-pipe thread or swivel-nut, meter-spud thread on 3 ¼ - inch and flange stops and 2-hole flange on 1 ½ and 2-inch sizes.
  4. Fittings: Provide approved fittings. Use same size open end wrenches and tapping machines as used with respective Mueller fittings.
  5. Factory Testing of Brass Fittings:
    - a. Submerge in water for 10 seconds at 85 psi with stop in both closed and open positions.
    - b. Reject fitting that shows air leakage. Contracting Officer may confirm tests locally. Entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

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- H. Angle Stops: In accordance with AWWA C 800; ground-key, stop type with bronze lockwing head stop cap; inlet and outlet threads conform to application tables of AWWA C 800; and inlets flared connection or compression.
  - 1. Outlet for 3/4-inch and 1-inch size: Meter swivel nut with saddle support.
  - 2. Outlet for 1 ½ -inch through 2-inch size: O-ring sealed meter flange, iron pipe threads.
- I. Fittings: In accordance with AWWA C 800 and following:
  - 1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.
  - 2. Nuts: Smooth cast and has symmetrical hexagonal wrench flats.
  - 3. Flare-Joint Fittings: Smooth cast. Machine seating surfaces for metal-to-metal seal to proper taper or curve, free from pits or protrusions.
  - 4. Thread fittings, of all types, shall have N.P.T. or AWWA threads, and protect male threaded ends in shipment by plastic coating, or approved equal.
  - 5. Compression tube fittings shall have Buna-N beveled gasket.
  - 6. Stamp of manufacturer's name or trademark and of fitting size on body.

**PART 3 EXECUTION****3.01 GENERAL**

- A. For service lines and lateral connections larger than those allowed in Pipe Tapping Schedule, branch connections and multiple taps may be used. Space corporation stops minimum of 2 feet apart.
- B. Tapped collars of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location.
- C. Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water lines.
- D. For new meter or when existing meter is in conflict with proposed pavement improvements, locate water meters one foot inside street right-of-way, or when this is not feasible, one foot on curb side of sidewalk. Contact Contracting Officer when major landscaping or trees conflict with service line and meter box location. No additional payment will be made for work on customer side of meter.

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- E. New location and installation of existing small meter shall conform to requirements of this Section.

### 3.02 SERVICE INSTALLATION

- A. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline.
- B. Install service lines in open-cut trench in accordance with Section 02317 - Excavation and Backfill for Utilities. Install service lines under paved roadways, other paved areas and areas indicated on Drawings in bored hole in accordance with Paragraph 3.01 G.
- C. Lay service lines with minimum of 30 inches of cover as measured from top of curb or, in absence of curbs, from centerline elevation of crowned streets or roads. Provide minimum of 18 inches of cover below flow line of ditches to service lines.
- D. Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Use only full lengths of tubing. Take care not to damage copper tubing when pulling it through hole. Compression-type union is only permitted when span underneath pavement cannot be accomplished with a full standard length of tubing. Use one compression-type union for each full length of tubing.
- E. Maintain service lines free of dirt and foreign matter.
- F. Install service lines so that top of meter will be 4 to 6 inches below finished grade.
- G. Anticipate existing sanitary sewers to have cement stabilized sand backfill to bottom of pavement. Include cost of such crossings in unit price for services.

### 3.03 CURB STOP INSTALLATION

- A. Set curb stops or angle stops at outer end of service line inside of meter box. Secure opening in curb stop to prevent unwanted material from entering. In close quarters, make S-curve in field. Do not flatten tube. In 3/4-inch and 1 - inch services, install meter coupling, swivel-nut, or curb stop ahead of meter. Install straight meter coupling on outlet end of meter.

### 3.04 SEQUENCE OF OPERATIONS

- A. Open trench for proposed service line in accordance with Section 02317 - Excavation and Backfill for Utilities.
- B. Install curb stop on meter end of service line.

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- C. With curb stop open and prior to connecting service line to meter in slack position, open corporation stop and flush service line thoroughly. Close curb stop, leaving corporation stop in full-open position.
- D. Check service line for apparent leaks. Repair leaks before proceeding.
- E. Schedule inspection with Contracting Officer prior to backfilling. After inspection, backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.
- F. Install meter box centered over meter with top of lid flush with finished grade. Meter box: Refer to Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

Table 02512

| PIPE TAPPING SCHEDULE                |              |           |           |           |
|--------------------------------------|--------------|-----------|-----------|-----------|
| WATERMAIN<br>TYPE AND DIAMETER       | SERVICE SIZE |           |           |           |
|                                      | 3/4"         | 1"        | 1-1/2"    | 2"        |
| 4" Cast Iron or Ductile Iron         | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 4" Asbestos Cement                   | WBSS         | WBSS      | DSS, WBSS | DSS, WBSS |
| 4" PVC (AWWA C900)                   | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Cast Iron or Ductile Iron  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Asbestos Cement            | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Cast Iron or Ductile Iron  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" PVC (AWWA C900)            | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" Cast Iron or Ductile Iron        | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" Asbestos Cement                  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" PVC (AWWA C900)                  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 16" and Up Cast Iron or Ductile Iron | DWBSS        | DWBSS     | DWBSS     | DWBSS     |
| 16" and Up Asbestos Cement           | DWBSS        | DWBSS     | DWBSS     | DWBSS     |
| 16" and Up PVC (AWWA C900)           | DWBSS        | DWBSS     | DWBSS     | DWBSS     |

DSS - DUAL STRAP SADDLES  
WBSS - WIDE BAND STRAP SADDLES  
DWBSS - DUAL WIDE BAND STRAP SADDLES

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END OF SECTION

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WET CONNECTIONS**

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**SECTION 02513****WET CONNECTIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wet connections for new watermains and service lines to existing watermains.

**1.02 REFERENCES**

- A. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

**1.03 DEFINITIONS**

- A. Wet connections consist of isolating sections of pipe to be connected with existing valves, draining isolated sections, and completing connections.
- B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of 2-inch service line.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Pipe shall conform to requirements of applicable portions of Sections 02501 through 02528 related to piping materials and to water distribution.
- B. Corporation cocks and saddles shall conform to requirements of Section 02512 - Water Tap and Service Line Installation.
- C. Valves shall conform to requirements of Section 02521 - Gate Valves.
- D. Brass fittings shall conform to requirements of AWWA C 800.

**PART 3 EXECUTION****3.01 CONNECTION OPERATIONS**

- A. Plan wet connections in manner and at hours with least inconvenience public. Notify Contracting Officer at least 72 hours in advance of making connections.



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WET CONNECTIONS**

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- B. Do not operate valves on water lines in use by American Water. American Water Utility Operations Division will handle, at no cost to Contractor operations involving opening and closing valves for wet connections.
- C. Conduct connection operations when AW Inspector is at job site. Connection work shall progress without interruption until complete once existing water lines have been cut or plugs have been removed for making connections.

**3.02 2-INCH WET CONNECTIONS**

- A. Tap water line. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing water line. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

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DISINFECTION OF WATERMAINS**

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**SECTION 02514****DISINFECTION OF WATERMAINS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Disinfection of potable watermains.

**1.02 REFERENCES**

- A. AWWA C 651 - Standard for Disinfecting Watermains.

**PART 2 PRODUCTS – Not Used****PART 3 EXECUTION****3.01 CONDUCTING DISINFECTION**

- A. Promptly disinfect watermains constructed before tests are conducted on watermains and before these watermains are connected to AW water distribution system.
- B. Water for disinfection and flushing will be furnished by AW without charge.
- C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations assisted by AW on-site field personnel.
- D. Coordinate chlorination operations through Contracting Officer.

**3.02 PREPARATION**

- A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new watermains prior to connection to AW water distribution system. Normally, each valved section of watermain requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for watermains up to and including 6-inch diameter.
- B. Use fire hydrants as blow-offs to flush newly constructed watermains 8-inch diameters and above. Where fire hydrants are not available on watermains, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in manner approved by Contracting Officer. Average water velocity when filling pipeline should be less than one

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foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

- D. Backfill excavations immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.
- F. If the main is 12 inches diameter or greater, the main should be pigged and then flushed at scouring velocity. See Section 02535 – Sanitary Sewer Force Mains Paragraph 3.04 for pigging procedure.

**3.03 DISINFECTION BY CONTRACTOR**

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
  - 1. Use not less than 100 parts of chlorine per million parts of water.
  - 2. Chlorinating material to watermains in accordance with AWWA C 651.
  - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
  - 4. Open and close valves in lines being sterilized several times during contact period.
  - 5. If chemical compound is used for sterilizing agent, place in pipes as directed by Contracting Officer.

**3.04 BACTERIOLOGICAL TESTING**

- A. After disinfection and flushing of water lines, bacteriological tests will be performed by an independent testing laboratory in accordance with Testing Laboratory Services. When test results indicate need for additional disinfection of water lines based upon State Department of Health requirements, Contractor shall assist AW with additional disinfection operations.

**3.05 COMPLETION**

- A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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HYDROSTATIC TESTING OF PIPELINES**

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**SECTION 02515****HYDROSTATIC TESTING OF PIPELINES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Field hydrostatic testing of newly installed watermain pipelines.

**PART 2 PRODUCTS – Not Used****PART 3 EXECUTION****3.01 PREPARATION**

- A. Disinfect newly constructed watermain pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed watermain pipelines after disinfection, when required, and before connecting to the water distribution system.
- C. Water for testing will be charged to Contractor in accordance with local AW billing rates. Prior to hydrostatic testing, obtain a transient meter from the American Water Operations Staff. Deposit is required for transient meter.
- D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.
- E. Conduct hydrostatic tests in presence of Contracting Officer and AW Project Manager.

**3.02 TEST PROCEDURES**

- A. Furnish, install, and operate connections, pump, meter and recording pressure gauges necessary for hydrostatic testing.
- B. Allow watermain pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water.
- C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter watermain, expel air and apply minimum test pressure of 150 psi.
- D. Begin test by 9:00 a.m. unless otherwise approved by Contracting Officer. Maintain test pressure for 8 hours. When large quantity of water is required to

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HYDROSTATIC TESTING OF PIPELINES**

maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.

- E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.
- F. Provide pipe sizes, lengths tested and amount of water required to bring the pressure in the pipe back to the initial pressure prior to the test with results of the leakage tests.

**3.03 ALLOWABLE LEAKAGE FOR WATERLINES**

- A. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.
- C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Contracting Officer and AW Project Manager for leakage during pressure test may be used to fulfill requirements of this section.

**3.04 CORRECTION FOR FAILED TESTS**

- A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- B. Contracting Officer may require failed lines to be disinfected after repair and prior to retesting. Conduct subsequent disinfection operations in accordance with requirements of Section 02514 - Disinfection of Water Lines. Pay for water required for additional disinfection and retesting.
- C. Repeat test until satisfactory results are obtained.

**3.05 COMPLETION**

- A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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**CUT, PLUG AND  
ABANDONMENT OF WATERMAINS**

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**SECTION 02516**

**CUT, PLUG AND ABANDONMENT OF WATERMAINS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Cut, plug and abandonment of watermain.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit product data for proposed plugs and clamps for approval.

**PART 2 PRODUCTS**

2.01 MATERIALS

- A. Concrete for reaction blocks: Class B conforming to requirements of Section 03315 - Concrete for Utility Construction.
- B. Plugs and clamps: Applicable for type of pipe to be plugged.

**PART 3 EXECUTION**

3.01 APPLICATION

- A. Do not begin cut, plug and abandonment operations until replacement watermain has been constructed, disinfected, and tested, and service lines have been transferred to replacement watermain.
- B. Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.
- C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than at supply watermain or as shown on Drawings.
- D. After watermain to be abandoned has been cut and plugged, check for other sources feeding abandoned watermain. When sources are found, notify Contracting Officer immediately. Cut and plug abandoned watermain at point of other feed as directed by Contracting Officer.

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- E. Plug or cap ends or openings in abandoned watermain in manner approved by Contracting Officer.
- F. Remove and dispose of surface identifications such as valve boxes and fire hydrants. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.
- G. Backfill excavations in accordance with Section 02317 - Excavation and Backfill for Utilities.
- H. Repair street surfaces in accordance with Section 02951- Pavement Repair and Resurfacing.

END OF SECTION

**FORT SILL  
STANDARD SPECIFICATION****FIRE HYDRANTS**

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**SECTION 02520****FIRE HYDRANTS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Fire hydrants.
- B. Adjustment of fire hydrants and gate valves.

**.02 REFERENCES**

- A. AWWA C 502 - Standard for Dry Barrel Fire Hydrants (Latest Edition).
- B. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants
- C. SSPC SP2 - Hand Tool Cleaning
- D. SSPC SP3 - Power Tool Cleaning
- E. SSPC SP10 - Near-White Blast Cleaning
- F. SSPC SP11 - Power Tool Cleaning to Bare Metal
- G. SSPC Paint Spec No.21
- H. SSPC-Paint 21 - White or Colored Silicone Alkyd Paint
- I. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
- J. SSPC-Paint 104 - White or Tinted Alkyd Paint
- K. Federal Standard A-A-2962A - Enamel, Alkyd, Solvent Based Low VOC

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit name of hydrant manufacturer, type of bonnet paint, and engineering control drawing number for hydrant proposed for use.

**PART 2 PRODUCTS****.01 HYDRANTS**

- A. Provide hydrants in conformance with AWWA C 502, Standard for Dry Barrel Fire Hydrants (Latest Edition). Hydrants are approved by AW by issuance of a Certificate of Responsibility. The following hydrants are approved with no



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substitutions.

|                         |   |
|-------------------------|---|
| HYDRANT                 | ENGINEERING CONTROL DRAWING – AMERICAN WATER  |
| Clow – 5 1/4” Medallion | D-20454 Rev. J dated 02/97<br>D-20455 Rev. B dated 06/20/00 and 94-20051 dated 10/26/94 |

- B. The Contracting Officer may, at any time prior to or during installation of hydrants, randomly select furnished hydrant for disassembly and laboratory inspection, at AW's expense, to verify compliance with Specifications. When a hydrant is found to be non-compliant, replace hydrant at Contractor's expense with a hydrant that complies with the Specifications.
- C. Provide lower hydrant barrel fabricated from Ductile Iron Pipe as single piece, connected to upper hydrant barrel by means of joint coupling that will provide three hundred sixty (360) degree rotation of upper barrel.

.02 LEADS

- A. Branches (Leads): Conform to requirements of Section 02501 - Ductile Iron Pipe and Fittings, Section 02506 - Polyvinyl Chloride Pipe.

.03 HYDRANT PAINTING

- A. New hydrants and refurbished hydrants shall be shop coated as specified herein.
- B. Exterior Above Traffic Flange (Including Bolts & Nuts).
  - 1. Surface preparation to be in accordance with SSPC-SP 10 (NACE 2) near white blast cleaned surface.
  - 2. Coat with three coat alkyd/silicone alkyd system with total dry film thickness (DFT) of 6 - 9 mils as follows:
    - a. Prime Coat - Oil modified alkyd primer, to be in general conformance with SSPC Paint Specification No. 25. Total dry film thickness (DFT) 2 - 3 mils.
    - b. Intermediate Coat - Heavy Duty Industrial Alkyd Enamel to be in general conformance with SSPC Paint Specification No. 104, and Federal Standard A-A-2962A. Total dry film thickness (DFT) of 2 - 3 mils.
    - c. Finish Coat - Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Total dry film thickness (DFT) to be 2 - 3 mils. Exception - hydrant bonnet shall not be finished shop coated, only intermediate coated. Install color coded finish coating of bonnet in field.
    - d. Bonnet Paint - Field apply finish coat of Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Dry film thickness of 2 - 3 mils. Bonnet colors are to be as specified in Paragraph 3.01 to designate the appropriate size of water supply line.

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3. Colors - Primer: Manufacturers standard color. Finish coat of hydrant body: ACRO 555 Crystal Blue or equivalent. Connection caps: Finished coated white. Paint white band of finish coat two inches in width on hydrant body approximately six inches above and parallel to traffic flange. Intermediate coat: Contrasting color to blue finish, such as white.
- C. Field Maintenance Painting (Exterior Above Traffic Flange)
1. Surface Preparation to be in accordance with SSPC - SP2, Hand Tool Cleaning, or SSPC - SP3, Power Tool Cleaning, depending on condition of existing paint and extent of corrosion. It is not necessary to remove tightly adhered mill scale, rust, and paint. Mill scale, rust and paint are considered tightly adherent when they cannot be removed with dull putty knife. In some severe cases where it is necessary to remove majority of existing paint, surface should be cleaned in accordance with SSPC -SP11, Power Tool Cleaning to Bare Metal.
  2. When surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new hydrants. When surface is cleaned to SSPC - SP2 or SSPC - SP3, coat hydrant with Silicone Alkyd Resin Enamel in general conformance with SSPC Paint Specification No. 21. Total dry film thickness of 3 - 6 mils surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new hydrants.
- D. Exterior Below Traffic Flange
1. Surface preparation in accordance with SSPC- SP10 (MACE 2) Near White Blast Cleaned Surface.
  2. Primer and intermediate coat: coal tar epoxy in general conformance with SSPC Paint Specification No. 16. Apply two (2) coats with dry film thickness (DFT) of 8 - 10 mils each for total DFT of 16 -20 mils.
  3. Finish coat: Water based vinyl acrylic mastic Apply one coat with dry film thickness of 6 - 8 mils. Color of finish coat to be same as finish coat for exterior above traffic flange, i.e., blue. (Acro 555 Crystal Blue, or equivalent.)
- E. Interior Surfaces Above and Below Water Line Valve
1. Material used for internal coating of hydrant interior ferrous surfaces below water line valve must meet the requirements of local state standards.
  2. Coating shall be liquid or powder epoxy system in accordance with AWWA Standard C - 550 (latest revision). Coating may be applied in two or three coats, according to manufacturer's recommendations, for total dry film thickness of 12 -18 mils.

**PART 3 EXECUTION****.01 INSTALLATION**

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**FIRE HYDRANTS**

- A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.
- B. Locate nozzle center line minimum 18 inches above finish grade.
- C. Place 12-inch by 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by Project Manager) on pumper nozzles of new or relocated fire hydrants installed on new water lines not in service. Remove indicators after new water line is tested and approved by Contracting Officer.
- D. Do not cover drain ports when placing concrete thrust block.
- E. Obtain Contracting Officer's approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Cost adjustments will not be allowed for changes in water line flow line or fire hydrant barrel length caused by obstructions.
- F. Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to nearest American Water Utility Maintenance Quadrant Facility.
- G. Install branches (leads) in accordance with Section 02511 – Water Mains.
- H. Coating Requirements:
  - 1. Apply coatings in strict accordance with manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.
  - 2. Furnish affidavit of compliance that coatings furnished complies with requirements of this specification and referenced standards, as applicable.
- I. Use following color code for field coating of hydrant bonnet to indicate size of water line supplying hydrant:

| <b>Supply Water Line Diameter (inches)</b> | <b>Bonnet Color</b> |
|--|---------------------|
| 6  | Yellow              |
| 8  | White               |
| 12-20                                      | Green               |
| 24 and larger                              | Orange              |

- J. Remove and dispose of unsuitable materials and debris in accordance with requirements of Waste Material Disposal.

**END OF SECTION**

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GATE VALVES**

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**SECTION 02521****GATE VALVES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Gate valves.

**1.02 REFERENCES**

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.
- C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.
- E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.
- F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.
- G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.
- H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

**1.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturer's product data for proposed valves for approval.
- D. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

**1.04 QUALITY CONTROL**

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- A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.
- B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 16 inches and smaller. When type of valve is indicated, no substitute is allowed.
- C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends
- D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.
- E. Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.
- F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:
1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
  2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.

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3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
  4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
  5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
  6. Stem Seals Consist of three O-rings, two above and one below thrust collar with antifriction washer located above thrust collar for operating torque.
  7. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
  8. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
  9. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
- G. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:
1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
  2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
  3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
  4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
  5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with antifriction washer located above thrust collar for operating torque.
  6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

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GATE VALVES**

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7. Discs: Cast iron with bronze disc rings securely penned into machined dovetailed grooves.
  8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
  9. Provide bypass for valves 24 inches and larger.
  10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
  11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
  12. Stuffing Boxes: Located on top of bonnet and outside gear case.
- H. Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.
1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
  2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
  3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
  4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
  5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
  6. Provide high strength bronze stem and nut.
  7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
  8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.

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9. Provide thrust washers to the thrust collar for easy valve operation.
- K. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.
- L. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Earthwork. Conform to applicable provisions of Section 02317 - Excavation and Backfilling for Utilities.
- B. Operation. Do not use valves for throttling without prior approval of manufacturer.

**3.02 SETTING VALVES AND VALVE BOXES**

- A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.
- B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.
- C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve. Assemble and brace box in vertical position as indicated on Drawings.

**3.03 DISINFECTION AND TESTING**

- A. Contractor shall disinfect valves and appurtenances as required by Section 02514 - Disinfection of Water Lines and test as required by Section 02515 - Hydrostatic Testing of Pipelines, with Contracting Officer in attendance.



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- B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- D. Repair or replace valves which exceed leakage rate.

**3.04 PAINTING OF VALVES**

- A. Paint valves in vaults, stations, and above ground with approved paint.

END OF SECTION

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**BUTTERFLY VALVES**

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**SECTION 02522**

**BUTTERFLY VALVES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Butterfly valves.

1.02 REFERENCES

- A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- B. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- C. AWWA C 504 - Standard for Rubber-Seated Butterfly Valves.
- D. AWWA C 550 - Standard for Protective Interior Coatings for Valves and Hydrants.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturer's product data for proposed valves and actuators for approval.
- C. Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications.
- D. Submit manufacturer's affidavit that butterfly valves were manufactured in the United States, and conform to applicable requirements of AWWA C 504 and that they have been satisfactorily tested in the United States in accordance with AWWA C 504 using test pressure of 150 psi in both directions. Submit Proof-of-Design and hydrostatic testing procedure in accordance with AWWA C 504.
- E. Submit manufacturer's affidavit that coating for interior surfaces of valves conform to applicable requirements of AWWA C 550. Submit results of holiday test and thickness measurements of coatings.
- F. Furnish, at time of delivery, affidavit of compliance, as specified in Section 6.3 of AWWA C 504 certifying compliance with applicable portion of AWWA C 504 and modification or supplements herein. Furnish certified drawings and material test records by manufacturer covering items included in Section 4.3 of AWWA C 504, for review. Furnish certified copies of test reports covering

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items in Sections 4.5.8.5.5, 4.5.8.5.8 and 5.2.1 through 5.2.4.3 of AWWA C 504 for review.

- G. Submit data indicating maximum torque required to open valve, maximum torsional strength of shaft and torque output of actuator.
- H. Provide submittal information on CD-ROM in Adobe portable document format (\*.PDF).
- I. Include number of turns to operate valves to fully open/closed.

**1.04 QUALITY CONTROL**

- A. Perform valve leakage tests in both directions at 150 psi in factory and field. Hydrostatic field tests of 150 psi shall be made against dished head plug or similar arrangement.
- B. For purposes of interpreting referenced AWWA tests, the following shall apply: Shutoff pressure is 150 psi; cycle consists of rotating disc from fully opened to fully closed position, for valves larger than 72 inches, proof of design shall require 1000 cycles and shall be performed on valve greater than 72 inches of like design and construction. When proof of design tests are performed on valve delivered to job site, replace disc, bushing, shaft and seals with new and unused items, and test and certify as described above.
- C. Hydrostatic Testing by Manufacturer:
  - 1. Hydrostatic testing to be witnessed by Contracting Officer prior to shipment of valves. Provide minimum 4 weeks notice to Contracting Officer to schedule witness testing. When possible, maximize number of valves to be tested during a plant visit, no more than two visits will be allowed per project to witness test valves, unless otherwise approved by Contracting Officer. Contracting Officer will pay expenses for each visit up to total of two visits incurred by Contracting Officer to witness testing of each grouping of valve(s) per project. Expenses for subsequent or extended visits by Contracting Officer for defective valves, improper scheduling or valve failures are to be paid by Contractor. Witness of hydrostatic testing by Contracting Officer will only be in regards to compliance with this specification and will not constitute approval by Contracting Officer nor relieve Contractor of obligations to comply with contract documents.
  - 2. Document serial number on valve at time of testing and reflect in certified test records furnished to Contracting Officer. Identification plate must be permanently affixed to valve and actuator prior to hydrostatic testing.
  - 3. Hydrostatic testing to conform to AWWA C504 except as modified below:
    - a. Install actuator prior to hydrostatic testing. Test actuator to verify actual number of turns match manufacturer's published number of turns.

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Verify valve stops are in correct positions.

- b. Fully open and close valve prior to performing shell test and prior to each leakage test.
- c. Perform shell test first.
- d. When tested with water, adequately dry seat and disc.
- e. When tested with air, fill top of valve with water to aid in viewing possible leakage.
- f. Pressure Gauges: Calibrated within past 12 months; 0-500 psi range in increments of 5 psi, present calibration certificates prior to hydrostatic testing.
- g. If seat adjustment is required during hydrostatic testing, perform valve leakage test again in both directions. Once seat adjustment is made, fully open and fully close valve three (3) times, and repeat leakage test.

4. Field Testing

- a. When valve arrives at the job site, Contractor is to operate valve fully open and closed twice in presence of Contracting Officer. Document number of turns to open and close each time.
- b. Install operator nut plum.
- c. After valve is installed, repeat the operation test and document number of turns in presence of Contracting Officer.
- d. Manufacturer's representative must be present to witness the operation test again at the substantial walk thru. Verify valve operates fully open/closed twice at the appropriate number of turns.

**PART 2 PRODUCTS****2.01 VALVES AND ACTUATORS**

- A. Butterfly Valves and Actuators: Provide approved butterfly valves and actuators. Conform to AWWA C 504, except as modified or supplemented herein.
- B. If type of valve is not indicated on Drawings, use butterfly valves for line valve sizes 24-inch and larger. When type of valve is specified on Drawings, no substitute will be allowed, unless otherwise approved by Contracting Officer.
- C. Butterfly valves shall be short-body, flanged design and installed at locations as shown on Drawings.

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- D. Direct-bury valves and valves in subsurface vaults shall open clockwise. Above-ground and plant valves shall open counterclockwise.

2.02 VALVE CONSTRUCTION

- A. Valves: AWWA C 504, Class 150B. Body: Cast iron, ASTM A 126, Class B. Flanges: ASME B 16.1, Class 125 lb.
- B. Discs for Butterfly Valves: Either cast iron or ductile iron. Valves greater than 54 in diameter must utilize flow through disc.
- C. Seats: Buna-N or neoprene, and may be applied to disc or body. Seats shall be mechanically secured and may not rely solely on adhesive properties of epoxy or similar bonding agent to attach seat to body. Seats on disc shall be mechanically retained by stainless steel (18-8) retaining ring held in place by stainless steel (18-8) cap screws that pass through rubber seat for added retention. When seat is on disc, seat shall be retained in position by shoulders located on both disc and stainless-steel retaining ring. Mating surfaces for seats: Type 304 or 316, stainless steel and secured to disc by mechanical means. Sprayed-on or plated mating surfaces will not be allowed. Seat must be replaceable in field for valves greater than 30 inches in diameter. Valves with segmented retaining rings will not be accepted.
- D. Coat interior wetted ferrous surfaces of valve, including disc, with epoxy suitable for potable water conditions. Epoxy, surface preparation, and epoxy application: In accordance with AWWA C 550 and coating manufacturer's recommendations. Provide three coats of two-component, high-build epoxy with minimum dry film thickness of 12 mils. Provide approved epoxy coating. Coatings shall be holiday tested and measured for thickness.
- E. Valve shaft and keys: 24 inches in diameter and greater valves require a minimum of two (2) taper pins used for attaching valve shaft to valve disc, use of torque plug for purposes of attaching valve shaft to valve disc is not permitted: Type 316 stainless steel. Shaft Bearings: Stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with proven record of preventing Teflon flow under load) in accordance with AWWA C 504. Sinter stainless steel bearing material. Design valve shaft to withstand 3 times amount of torque necessary to open valve.
- F. Packing: Self adjusting and wear compensating, full or split ring V-type, and replaceable without removing actuator assembly.
- G. Retaining Hardware for Seats: Type 304 or 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats shall be held securely with lock tight, or other approved method, to prevent loosening by vibration or cavitation effects.

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- H. Valve disc shall seat in position at 90 degrees to pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Install valves with valve shafts horizontal and convex side of disc facing anticipated direction of flow, except where shown otherwise on Drawings.
- I. For valves utilizing retaining rings, tighten bolts to a uniform torque. Measure torque prior to testing valve.

**2.03 VALVE ACTUATOR CONSTRUCTION**

- A. Provide actuators for valves with size based on line velocity of 12 feet per second and uni-directional service, and, unless otherwise shown on Drawings, equip with geared manual actuators. Provide fully enclosed and traveling-nut type, rack-and-pinion type, or wormgear type for valves 20 inches and smaller. Provide worm-gear type for valves 24 inches and larger.
- B. Provide actuator designed for installation with valve shaft horizontal unless otherwise indicated on Drawings.
- C. Provide bonnet extensions, as required, between valve body and actuator. Space between actuator housing and valve body shall be completely enclosed so that no moving parts are exposed to soil or elements.
- D. Provide oil-tight and watertight actuator housings for valves, specifically designed for buried service or submerged service when located in valve vaults, and factory packed with suitable grease.
- E. Install valve position indicator on each actuator housing located above ground or in valve vaults. Valves shall be equipped with 2-inch actuator nut only.
- F. Indicate direction of opening of valve on exposed visible part of assembly and cast direction of open on 2 inch nut on top of valve operator extension. Paint 2 inch actuator nut and extension shaft black when counter clockwise open and red when clockwise to open.
- G. Design worm-gear or traveling-nut actuators to be self-locking and designed to transmit twice the required actuator torque without damage to faces of gear teeth or contact faces of screw or nut.

**2.04 VALVE BOXES**

- A. Provide Standard Type "A" valve boxes conforming to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

**2.05 VALVE SERVICE CHAMBERS**

- A. For large diameter watermain (20-inch or larger), provide chambers to dimensions shown on Drawings conforming to requirements of Section 02082 - Precast Concrete Manholes.

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**PART 3 EXECUTION****3.01 EARTHWORK**

- A. Conform to applicable provisions of Section 02317 - Excavation and Backfill for Utilities.

**3.02 SETTING VALVES AND VALVE BOXES**

- A. Prior to Hydrostatic testing of watermain and valve:
  - 1. Test valve by opening and closing valve at a minimum of two times to verify valve seats properly.
  - 2. Verify number of turns from fully open to fully closed position is same as identified in manufacturer's submittal.
  - 3. Adjust valve as required if number of turns do not match.
  - 4. Remove foreign matter from within valves.
- B. Install valves where shown on Drawings or as located by Contracting Officer. Use valve boxes for 16 inch and 24 inch valves. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet.
- C. Avoid disturbing or overstressing valve body when installing valves. Perform field adjustment of valves under pressure to ensure shutoff occurs in number of rotations as described in valves operation and maintenance manual.
- D. Attach two four (4) foot lengths of pipe to each side of valve prior to installation in line.
- E. Submit certification that large diameter valve was installed, adjusted, and exercised in accordance with manufacturer's instructions. Manufacturer's certification shall state that all performance characteristics of large diameter valves, as installed, have been met. Adjustments made to valve, for any reason, must be made by manufacturer's representative.

**3.03 DISINFECTION AND TESTING**

- A. Contractor shall perform disinfection of valves and appurtenances as required by Section 02514 - Disinfection of Watermains and test as required by Section 02515 - Hydrostatic Testing of Pipelines in attendance of Contracting Officer. Do not use valves for throttling without prior approval of manufacturer.

**3.04 COATING OF PIPING**

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- A. Coat valves located in vaults, stations, and above ground using approved paint. Minimum of two (2) coats shall be applied with minimum of three (3) mil thickness. Apply coating in accordance with manufacturer's recommendations.

END OF SECTION



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PRESSURE REDUCING VALVES**

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**SECTION 02523****PRESSURE REDUCING VALVES****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Pressure reducing valves (PRV).

**.02 REFERENCES**

- A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- B. ASTM A 48 - Standard Specification for Gray Iron Castings.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturer's product data for proposed valves for approval.
- C. Submit design calculations and shop drawings for valve vaults and manholes, sealed by Engineer registered in the State that the project is in.

**.04 QUALITY CONTROL**

- A. Submit manufacturer's affidavit that pressure reducing valves purchased for Work, were manufactured and tested in the United States, and conform to requirements of this Section.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Provide approved PRV with basket strainer in location and arrangement as shown on Drawings.
  - 1. Valve body: Ductile iron with ASME B16.1, Class 125, flanges.
  - 2. Valve cover: ASTM A 48 cast iron.
  - 3. Valve internals:
    - a. Provide top and bottom single moving disc and diaphragm assembly.
    - b. Use flexible nylon fabric reinforced elastomer diaphragm integral with assembly.
    - c. Provide valve internal trim (seat ring, disc guide, and cover bearing)

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- made of stainless steel.
- d. Provide heat fusion bonded epoxy coating to internal and external surfaces of valve body including disc retainer and diaphragm washer. Holiday test coating applied to valve body.
- e. Treat stem and seat with penetrative salt nitride process.
- f. Use Xylan coated seat.
- g. Do not use leather parts.
- B. Control Tubing: Contain shutoff cocks with Y-strainer.
- C. PRV: Equip with visual valve position indicator. Fit valve position indicator with air-bleed petcock. Initially set in field by authorized manufacturer's representative with 60 psi downstream pressure.
- D. Provide basket strainer upstream of PRV as shown on Drawings.
  - 1. Strainer body: Quick-opening type, fabricated-steel construction with ANSI B 16.1, Class 150, flanges.
  - 2. Basket: Type 304, stainless steel.
  - 3. Model: Provide basket compatible with the manufacturer of the pressure reducing valve. Hayward Model 90, or approved equal, for PRV 4 inches through 24 inches. Provide Hayward Model 510, or approved equal, for PRV 14 inches or greater when space limitations dictate use of smaller strainer housing.
- E. Provide pressure reducing pilot that has adjustable range of 20 - 175 psi. Provide and install pilot system components according to manufacturer's recommendations unless otherwise approved by Contracting Officer.
- F. Valve Vaults: Provide as shown on Drawings and conforming to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

**PART 3 EXECUTION****.01 EARTHWORK**

- A. Conform to applicable provisions of Section 02317 - Excavation and Backfill for Utilities.

**.02 SETTING VALVES**

- A. Provide services of technical representative of valve manufacturer on site during installation of valves and to serve as adviser on aspects of installation. Take necessary precautions to protect pilot system during PRV installation.
- B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.

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.03 DISINFECTION AND TESTING

- A. Disinfect valves and appurtenances as required by Section 02514 - Disinfection of Water Lines and test as required by Section 02515 - Hydrostatic Testing of Pipelines.

.04 PAINTING OF PIPING AND VALVES

- A. Paint piping and valves located in vaults, stations, and above ground using ACRO Paint No. 2215, or approved equal.

**END OF SECTION**

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TAPPING SLEEVES AND VALVES**

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**SECTION 02525****TAPPING SLEEVES AND VALVES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tapping sleeves and valves for connections to existing water system.

**1.02 REFERENCES**

- A. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
- B. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- C. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High-Temperature Service
- D. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.
- E. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.
- F. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in.
- G. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

**1.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit results of tapping sleeves NPT test opening.
- C. Submit manufacturer's affidavit as required in Section 02521 - Gate Valves.

**1.04 DELIVERY, STORAGE AND HANDLING**

- A. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

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**PART 2      PRODUCTS****2.01    MATERIALS****A.      Tapping Sleeves:**

1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
2. Branch Outlet of Tapping Sleeve:
  - a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
  - b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Use cast iron split sleeve where fire service from 6-inch watermain is approved.

**B.      Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:**

1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
8. Provide approved steel tapping sleeves
9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.

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10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.
- C. Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
1. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
  2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
  3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
  4. Body: ASTM A240 Stainless Steel, Type 304.
  5. Bolts: ASTM A193 Stainless Steel, Type 304.
  6. Nuts: ASTM A194 Stainless Steel, Type 304
  7. Branch Outlet: Heavy Stainless Steel Pipe
  8. Provide approved stainless steel tapping sleeves.
  9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.
- D. Tapping Valves: Meet requirements of Section 02521 - Gate Valves with following exceptions:
1. Inlet Flanges:
    - a. AWWA C 110; Class 125.
    - b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
  2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
  3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.
- D. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

**PART 3 EXECUTION****3.01 APPLICATION**

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- A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.
- B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.
- C. Hydrostatically test installed tapping sleeve to 150 psi for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.
- D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.
- E. Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

**3.02 INSTALLATION**

- A. Verify outside diameter of pipe to be tapped prior to ordering sleeve.
- B. Tighten bolts in proper sequence so that undue stress is not placed on pipe.
- C. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.
- D. Make tap with sharp, shell cutter:
  - 1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
  - 2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.
- E. Withdraw coupon and flush cuttings from newly- made tap.
- F. Wrap:
  - 1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Section 02528 - Polyethylene Wrap.
  - 2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.

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- G. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).
- H. Request inspection of installation prior to backfilling.
- I. Backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.

END OF SECTION



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WATER METERS**

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**SECTION 02526****WATER METERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Water meters, sub-meters, and fire service meters.

**1.02 REFERENCES**

- A. ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
- B. AWWA C 510 - Standard for Double Check Valve Backflow - Prevention Assembly.
- C. AWWA C 700 - Standard for Cold-Water Meters - Displacement Type.
- D. AWWA C 701 - Standard for Cold-Water Meters - Turbine Type for Customer Service.
- E. AWWA C 702 - Standard for Cold-Water Meters - Compound Type.
- F. AWWA C 703 - Standard for Cold-Water Meters - Fire Service Type.
- G. AWWA Manual M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

**1.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit written certification of calibration and test results.
- C. Submit manufacturer's certification that water meters meet applicable requirements of this Specification Section.
- D. Submit accuracy registration test certification from manufacturer for each 3-inch through 10 inch diameter meter.

**1.04 QUALITY CONTROL**

- A. Submit manufacturer's warranty against defects in materials and workmanship for one (1) year from date of Substantial Completion.

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- B. Provide vendor's unconditional guarantee that performance of each meter meets applicable AWWA standards and AWWA Manual M6 as follows:
1. Displacement type: 10 years from installation or register registration shown below, whichever comes first.
 

| Size<br>(inch) | Registration (million gallons) |
|----------------|--------------------------------|
| 5/8,3/4        | 1.5                            |
| 1              | 2.5                            |
| 1-1/2          | 5.0                            |
| 2              | 10.5                           |
  2. Turbine type: 1 year from date of installation.
  3. Compound type: 1 year from date of installation.
  4. Fire service type: 1 year from date of installation,

Operations of hermetically sealed register, 5/8-inch to 2-inch diameter, shall be unconditionally guaranteed for 15 years.

- C. Provide manufacturer's unconditional guarantee for each sealed register against leakage, fogging, discoloration and stoppage for 15 years from date of Installation.
- D. Vendor may replace meters that become defective within guarantee period with meters that comply with this Specification. Defective meters will be returned to the vendor at vendor's expense. Meters repaired or replaced under this guarantee must meet accuracy limits for new meters upon receipt and accuracy limits for remaining period of initial guarantee.

#### **1.05 EASEMENT REQUIREMENTS**

- A. Install 2-inch and smaller water meters and shut-off valves (stop boxes) at right-of-way line when possible. Otherwise, install within 5 foot by 5 foot water meter easement.
- B. Except for 10-inch fire service compound water meters, install 3-inch and larger water meters within minimum of 10 foot by 20 foot water meter easement.
- C. Install 10-inch fire service proportional or compound water meters within minimum of 10-foot by 25-foot water meter easement.
- D. Locate water meter easements contiguous with public right-of-way unless approved by Contracting Officer. Provide minimum fifteen-foot wide access easement when not contiguous with public right-of-way.

## **PART2 PRODUCTS**

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2.01 GENERAL

- A. Provide meters of type and size as indicated on Drawings, unless otherwise indicated.
- B. Provide bolted split casings. Main casings of meters and external fasteners: Copper alloy with minimum 75 percent copper for 5/8 inch to 2 inches, bronze or cast iron, hot-dipped galvanized or epoxy coating for 3 inches and larger.
- C. Straightening Vanes: Non-corrosive material compatible with case material.
- D. Intermediate gear train shall not come into contact with water and shall operate in suitable lubricant.
- E. Registers: Automatic Meter Reading (AMR) type that provides pulse, contact closure, piezo switch or encoder generated output signal, compatible with AWS radio and telephone AMR systems. Provide minimum 12-foot wire when permanently connected to register. Lens: impact resistant. Register box: tamper resistant by means of tamper screw or plug; Register: permanently sealed, straight-reading, center-sweep test hand, magnetic driven, U.S. gallons. Digits: 6, black in color, with lowest registering 3 digits (below 1,000-gallon registration) having contrasting digit and background color. Register capacity of meters: 9.99 million gallons for 5/8 inch to 2 inches and 999.999 million gallons for 3 inches and larger.
- F. Connections: 5/8 inch to 1 inch: threads at each end; 1-1/2 to 2 inches: 2-bolt oval flanges each end; 3 inches and larger: flange at each end.
- G. Stamp manufacturer's meter serial number on outer case. Stamp manufacturer's meter serial number on outside of register lid when provided. Manufacturer's serial numbers shall be individual and not duplicated.
- H. Water Meters: Provide approved meters equip with AMR type register to connect to American Water AMR system. Water Meter to be: 'Neptune Model T10' (ProRead Gallon 6 wheel plastic bottom) with 'Neptune Model R900v2 – pit style MIU c/w 6-ft of wire) with no substitutions. Water Meter to be supplied with a 'McDonald' Cast Iron Yoke as shown on standard detail drawings for locations where directed by Contracting Officer.
- I. Manufacturing Quality Control shall permit successful interchangeability from one meter to another of same size including registers, measuring chambers and units, discs or pistons as units, change gears, bolts, nuts, and washers without affecting accuracy of new meter.
- J. For water meter vaults provide:

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1. Water Meter Vault to be: 'Alliance Model 16 AMR Series' as manufactured by 'DFW Plastics INC. Minimum outside dimensions, 25 1/4 " x 19 3/8". 'AMR' – 'Automatic Meter Reader' type lid shall be provided with a horseshoe type opening cover plate for the installation of the antenna for the MIU. Provide meter box extensions as manufactured by 'Alliance' to suit depth of water meter installation.
2. 1/4-inch steel or aluminum with stainless steel hinge pins. Door shall open to 90 degrees and automatically lock in that position.
3. Provide approved meter vault covers.

**2.02 METER APPLICATIONS**

- A. Sizes 5/8-inch to 2-inch Meters: Displacement type (except for constant flow where 2-inch turbine may apply).
- B. Sizes 3-inch and above Meters:

1. Turbines:

Lawn sprinkler systems  
Sewer credit/sub-meter

2. Compounds:

Motels and hotels  
Schools  
Restaurants  
Office buildings  
Dormitories, nursing homes, department stores, shopping malls, and other commercial establishments

Note: Provide fire service type for sizes larger than 6 inches.

3. Fire Service Type: For designated fire protection lines. Provide proportional or compound type fire service meter assembly (AWWA C 703) when customer elects to use combination of potable and fire protection services in lieu of separate domestic meters and fire services.

**2.03 MATERIALS**

- A. Cold-Water Meters:

1. Displacement Type: AWWA C 700; sizes 5/8 inch up to and including 2 inches; oscillating disc or piston of magnetic drive type; bolted split-case design, with either being removable.

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2. Turbine Type: AWWA C 701; Class II; sizes 3 inches through 10 inches; flanged; straight-through measuring chamber; rotor construction: polypropylene or similar non rubber material with specific gravity of approximately 1.0, equipped with near frictionless replaceable bearings in turbine working against rotor shaft positioned thrust bearing. Transient/Fire Hydrant Meter Inlet: Female fitting for attachment to hose nozzle with National Standard Fire hose thread. Outlet: 2-inch nipple with National Pipe Thread. Include restriction plate to limit flow through meter to 400 gpm at 65 psi.
3. Compound Type: AWWA C 702; sizes 2 inches through 6 inches. Measuring chambers: For use in continuous operation; separate units of copper alloy (minimum 84 percent copper) or approved polymer material, inert in corrosive potable water; with centering device for proper positioning. Measuring pistons: Non-pilot type with division plates of rubber covering vulcanized to stainless steel or other approved material of sufficient thickness to provide minimum piston oscillation noise. Measuring discs: Flat or conical type, one piece, mounted on monel or 316 stainless steel spindle. Measuring chamber strainer screen area: Twice area of main case inlet.
4. Fire-Service Type: sizes 4 inches through 10 inches; turbine-type, compound type, proportional type; AWWA C 703, with separate check valve conforming to AWWA C 510. Determine size of fire meter by adding fire flow and domestic flow.

**2.04 STRAINERS**

- A. Displacement Potable Water Meters 5/8 inch through 2 inches: Self-straining by means of annular space between measuring chamber and external case or with strainer screens installed in meter. Provide rigid screens which fit snugly, are easy to remove, with effective straining area at least double that of main case inlet.
- B. Potable Water Meters 2-inch diameter and larger: Equip with separate external strainer with bronze body for diameters less than 8 inches. 8-inch diameter and larger may be cast iron, hot-dipped galvanized or epoxy coating. Strainers: Bolted to inlet side of meter, detachable from meter, easily removable lid. Strainer screen: Made of rounded cast bronze, stainless steel wire, having nominal screen size of 3-1/2 mesh-per-inch (U.S. Series) not less than 45 percent clear area.
- C. Provide separate approved external strainers (when required by meter manufacturer) approved for use in fire service metered connections by Underwriters Laboratories. Bodies: Cast iron or copper alloy. Ends: Flanged in accordance with ASME B 16.1, Class 125. Provide stainless steel basket. Strainers shall be detachable from meter.

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**2.05 CONNECTIONS AND FITTINGS**

- A. Provide pipe for connections in accordance with Section 02501 - Ductile Iron Pipe and Fittings and Section 02506 - Polyvinyl Chloride Pipe. Use restrained joints and flanged joints only.
- B. Fittings:
  - 1. For meters 2 inches and smaller: Same type of fittings as Outlet End fittings for Curb Stop in accordance with Section 02512 - Water Tap and Service Line Installation.
  - 2. For meters 3 inches and larger: Restrained ductile iron; push-on bell joints or mechanical joint fittings between water line and meter vault; Class 125 flanged inside meter vaults; cement mortar lined and sealed.

**2.06 LAYING LENGTHS**

- A. Minimum laying lengths for meter and standard strainer shall be as shown on Drawings.

**PART 3 EXECUTION****3.01 TAPPING AND METER SERVICE INSTALLATION**

- A. Meter Service Line:
  - 1. Use pipe and fittings conforming to requirements of Section 02501 - Ductile Iron Pipe and Fittings, or Section 02506 - Polyvinyl Chloride Pipe.
  - 2. Limit pulling and deflecting of joints to limits recommended by manufacturer.
  - 3. Make vertical adjustments with offset bends where room will permit. Minimize number of bends.
  - 4. Provide minimum of ten pipe diameters of straight pipe length upstream and downstream of meter vault.

**3.02 METER FITTING HOOKUP**

- A. Support meter piping and meter, level and plumb, during installation. Support meters 3 inches and larger with concrete at minimum of two locations.
- B. Use round flanged fittings inside meter box or vault except for mechanical joint to flange adapter. Provide full-face 1/8-inch black neoprene or red rubber

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gasket material on flanged joints. Provide bolts and nuts made from approved corrosion-resistant material.

- C. Tighten bolts in proper sequence and to correct torque.
- D. Visually check for leaks under normal operating pressure following installation. Repair or replace leaking components.

### 3.03 METER BOX AND VAULT INSTALLATION

- A. Conform to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.
- B. Perform adjustment to existing meter in accordance with Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

### 3.04 TESTING

- A. Accuracy registration tests will be conducted in accordance with latest revision of AWWA standard for type and size of meter.
  - 1. Tests will be run by Contractor on meters prior to installation at manufacturing plant with attendance of Contracting Officer. Meters 2 inches and smaller will be tested at random at Contracting Officer's discretion. All 3 inches and larger meters will be tested.
  - 2. Accuracy of displacement meters during guarantee period shall be as follows:
    - a. Initial period: of 18 months from date of shipment or 12 months from date of installation: 98.5% to 101.5% at standard and minimum flow rates; 98% to 101% at low flow rates.
    - b. Second period: AWWA new meter accuracy as tested below.

| Meter Size<br>(inches) | <u>GUARANTEE PERIOD</u> |                           | <u>TEST FLOW RATE</u> |
|------------------------|-------------------------|---------------------------|-----------------------|
|                        | Age of Meter<br>(Years) | Or<br>Million*<br>Gallons | Minimum Rate<br>(gpm) |
| 5/8                    | >1 to <5                | 0.5                       | 1/4                   |
| 1                      | >1 to <5                | 1.0                       | 3/4                   |
| 1-1/2                  | >1 to <5                | 2.5                       | 1-1/2                 |
| 2                      | >1 to <5                | 5.5                       | 2                     |

\* Total registration.

- c. Third period: AWWA new meter accuracy for standard flow rates and AWWA repair meter accuracy for minimum flow rate as tested below.

GUARANTEE PERIOD

TEST FLOW RATE

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| Meter Size<br>(inches) | Age of Meter<br>(Years) Or | Million*<br>Gallons | Minimum Rate<br>(gpm) |
|------------------------|----------------------------|---------------------|-----------------------|
| 5/8                    | >5 to <10                  | 1.5                 | 1/4                   |
| 1                      | >5 to <10                  | 2.5                 | 3/4                   |
| 1-1/2                  | >5 to <10                  | 5.0                 | 1-1/2                 |
| 2                      | >5 to <10                  | 10.0                | 2                     |

3. Minimal acceptable accuracy in percent of low flow registration for turbine meters:

| <u>Meter Size</u><br><u>(inches)</u> | <u>Minimum Flow</u><br><u>(gpm)</u> | <u>% Accuracy</u><br><u>Required</u> |
|--------------------------------------|-------------------------------------|--------------------------------------|
| 2                                    | 3                                   | 95                                   |
| 3                                    | 5                                   | 95                                   |
| 4                                    | 15                                  | 95                                   |
| 6                                    | 20                                  | 95                                   |
| 8                                    | 20                                  | 95                                   |
| 10                                   | 30                                  | 95                                   |

END OF SECTION



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POLYETHYLENE WRAP**

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**SECTION 02528****POLYETHYLENE WRAP****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Polyethylene wrap to be used in open-cut construction for cast iron and ductile iron pipe when cathodic protection system is not required by Drawings.

**.02 REFERENCE**

- A. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials For a Wire and Cable.
- B. AWWA C 105 - Standard for Polyethylene Encasement for Ductile-Iron Pipe System.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit product data for proposed film and tape for approval.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Polyethylene Film: Tubular or sheet form without tears, breaks, holidays, or defects; conforming with requirements of AWWA C 105, 2.5 to 3 percent carbon black content, either low- or high-density:
  - 1. Low-density polyethylene film. Low-density polyethylene film shall be manufactured of virgin polyethylene material conforming to following requirements of ASTM D 1248.
    - a. Raw material.
      - 1. Type 1
      - 2. Class: C (black).
      - 3. Grade: E-5.
      - 4. Flow rate (formerly melt index): 0.4 g/10 minute, maximum.
      - 5. Dielectric strength: Volume resistivity,  $10^{15}$  ohm-cm, minimum
    - b. Physical properties.
      - 1. Tensile strength: 1,200 psi, minimum.

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2. Elongation: 300 percent, minimum.
  3. Dielectric strength: 800 V/mil thickness, minimum.
  - c. Thickness: Low-density polyethylene film shall have normal thickness of 0.008 inch. Minus tolerance on thickness is 10 percent of nominal thickness.
2. High-density, cross-laminated polyethylene film. High-density, cross laminated polyethylene film shall be manufactured of virgin polyethylene material conforming to following requirements of ASTM D 1248
  - a. Raw material.
    1. Type: III.
    2. Class: C (black)
    3. Grade: P33.
    4. Flow rate (formerly melt index): 0.4 to 0.5g/10 minute, maximum.
    5. Dielectric strength: Volume resistivity,  $10^{15}$  ohm-cm, minimum.
  - b. Physical properties.
    1. Tensile strength: 5000 psi, minimum.
    2. Elongation: 100 percent, minimum.
    3. Dielectric strength: 800 V/mil thickness, minimum.
  - c. Thickness: Film shall have nominal thickness of 0.004 inch. Minus tolerance of thickness is 10 percent of nominal thickness.
- B. Polyethylene Tape: Provide 3-inch-wide, plastic-backed, adhesive tape; Paleocene No. 900, Scotchwrap No. 50, or approved equal.

**PART 3 EXECUTION****.01 PREPARATION**

- A. Remove lumps of clay, mud, and cinders from pipe surface prior to installation of polyethylene encasement. Prevent soil or embedment material from becoming trapped between pipe and polyethylene.
- B. Fit polyethylene film to contour of pipe to affect snug, but not tight fit; encase with minimum space between polyethylene and pipe. Allow sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to polyethylene due to backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.
- C. For installations below water table or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.

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.02 INSTALLATION

A. Tubular Type (Method A):

1. Cut polyethylene tube to length approximately 2 feet longer than pipe section. Slip tube around pipe, centering tube to provide 1-foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears pipe ends.
2. Lower pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene tube.
3. After assembling pipe joint, make overlap of polyethylene tube. Pull bunched polyethylene from preceding length of pipe, slip it over end of adjoining length of pipe, and secure in place. Then slip end of polyethylene from adjoining pipe section over end of first wrap until it overlaps joint at end of preceding length of pipe. Secure overlap in place. Take up slack width at top of pipe to make snug, but not tight, fit along barrel of pipe, securing fold at quarter points.
4. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

B. Tubular Type (Method B):

1. Cut polyethylene tube to length approximately 1 foot shorter than pipe section. Slip tube around pipe, centering it to provide 6 inches of bare pipe at each end. Take up slack width at top of pipe to make snug, but not tight, fit along barrel of pipe, securing fold at quarter points; secure ends.
2. Before making up joint, slip 3-foot length of polyethylene tube over end of preceding pipe section, bunching in accordion-fashion lengthwise. After completing joint, pull 3-foot length of polyethylene over joint, overlapping polyethylene previously placed on each adjacent section of pipe by at least 1 foot; make each end snug and secure.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

C. Sheet Type:

1. Cut polyethylene sheet to length approximately 2 feet longer than pipe section. Center length to provide 1-foot overlap on each adjacent pipe section, bunching sheet until it clears pipe ends. Wrap polyethylene around pipe so that sheet circumferentially overlaps top quadrant of pipe. Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.
2. Lower wrapped pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene. After completing joint, make overlap and secure ends.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

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- D. Pipe-shaped Appurtenances: Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in same manner as pipe.
- E. Odd-shaped Appurtenances: When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces in tube, wrap with flat sheet or split length of polyethylene tube by passing sheet around appurtenance and encasing it. Make seams by bringing edges together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.
- F. Openings in Encasement: Create openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making X-shaped cut in polyethylene and temporarily folding back film. After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene, with tape. Service taps may also be made directly through polyethylene, with resulting damaged areas being repaired as specified.
- G. Junctions between Wrapped and Unwrapped Pipe: Where polyethylene-wrapped pipe joins adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet. Secure end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from cast or ductile iron pipe.

**.03 REPAIRS**

- A. Repair cuts, tears, punctures, or damage to polyethylene with adhesive tape or with short length of polyethylene sheet or cut open tube, wrapped around pipe to cover damaged area, and secured in place.

**END OF SECTION**

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**GRAVITY SANITARY SEWERS****SECTION 02531****GRAVITY SANITARY SEWERS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

**.02 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Contracting Officer.

**.03 QUALITY ASSURANCE**

- A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02533 - Acceptance Testing for Sanitary Sewers.
- B. Regulatory Requirements.
  - 1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
  - 2. Make notification to Contracting Officer when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
  - 3. Lay gravity sewer lines in straight alignment and grade.

**.04 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Inspect pipe and fittings upon arrival of materials at job site.
- B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.

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- C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

**PART 2 PRODUCTS****.01 PIPE**

- A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.
- B. Unlined reinforced concrete pipe is not acceptable.

**.02 PIPE MATERIAL SCHEDULE**

- A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of following Sections:
  - 1. Section 02427 - Plastic Liner for Large-Diameter Concrete Sewers and Structures.
  - 2. Section 02501 - Ductile Iron Pipe and Fittings.
  - 3. Section 02505 - High Density Polyethylene (HDPE) Solid and Profile Wall Pipe.
  - 4. Section 02506 - Polyvinyl Chloride Pipe.
- B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

**.03 APPURTENANCES**

- A. Stacks. Conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections.
- B. Service Connections. Conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections.
- C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

**.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL**

- A. Bedding and Backfill: Conform to requirements of Section 02317 - Excavation and Backfill for Utilities, Section 02320 - Utility Backfill Materials.
- B. Topsoil: Conform to requirements of Section 02911 - Topsoil.

**PART 3 EXECUTION**

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**.01 PREPARATION**

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Traffic Control and Regulation.
- B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected.
- C. Perform work in accordance with OSHA standards. Employ trench safety system for excavations over 5 feet deep.
- D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Contracting Officer and agency or utility company for repairs or relocations, either temporary or permanent.
- E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.
- F. Install and operate dewatering and surface water control measures in accordance with contract document requirements.
- G. Do not allow sand, debris or runoff to enter sewer system.

**.02 DIVERSION PUMPING**

- A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Contracting Officer.
- B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.
- C. No sewage shall be diverted into area outside of sanitary sewer.
- D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Contracting Officer so that required reporting can be made to State Environmental Agency and Environmental Protection Agency by Contracting Officer and AW Project Manager.

**.03 EXCAVATION**

- A. Earthwork. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Contracting Officer. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of

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appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.

- C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 02317 - Excavation and Backfill for Utilities.

**.04 PIPE INSTALLATION BY OPEN CUT**

- A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Contracting Officer.
- C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.
- E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe
- G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Contracting Officer.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.
- K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.
- L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

**.05 PIPE INSTALLATION OTHER THAN OPEN CUT**



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- A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

.06 INSTALLATION OF APPURTENANCES

- A. Service Connections. Install service connections to conform to requirements of Section 2534 - Sanitary Sewer Service Stubs or Reconnections.
- B. Stacks. Construct stacks to conform to requirements of 02534 - Sanitary Sewer Service Stubs or Reconnections.
- C. Construct manholes to conform to requirements of Section 02081 - Cast-in-Place Concrete Manholes, Section 02082 - Precast Concrete Manholes as applicable. Install frames, rings, and covers to conform to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

.07 INSPECTION AND TESTING

- A. Visual Inspection: Check pipe alignment in accordance with Section 02533 - Acceptance Testing for Sanitary Sewers.
- B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Section 02533 - Acceptance Testing for Sanitary Sewers.
- C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Section 02533 - Acceptance Testing for Sanitary Sewers.

.08 BACKFILL AND SITE CLEANUP

- A. Backfill and compact soil in accordance with Section 02317 - Excavation and Backfill for Utilities.
- B. Backfill trench in specified lifts only after pipe installation is approved by Project Manager.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 02951 - Pavement Repair and Resurfacing.
- D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil as specified in Section 02911 - Topsoil and apply hydromulch according to requirements of Section 02921 - Hydromulch Seeding.
- E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of

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4 inches of topsoil per Section 02911 - Topsoil. Sod disturbed areas in accordance with Section 02922 - Sodding.

.09 POST-INSTALLATION TELEVISION INSPECTION

- A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.
- B. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.
- C. Perform television inspection of gravity sanitary sewers as follows:
  - 1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
  - 2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
  - 3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.
- D. Provide video tapes in VHS format, recorded at Standard Play (SP). Two labels are required. Place one label on spine and other on face of each video tape. Permanently label each video tape with following information.

Spine of Tape

|                      |   |                    |       |
|----------------------|---|--------------------|-------|
| Wastewater File No.: | _____   | Contractor's Name: | _____ |
| Inspection Type:     | [ ] Survey [ ] Pre-Installation [ ] Post-Installation |                    |       |
| Tape No.:            | _____   | Date Televised:    | _____ |
| Basin No:            | _____   | Date Submitted:    | _____ |

Face of Tape

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| Manhole No.<br>From | Manhole No. To | Pipe Diameter | Pipe Length | Street |
|---------------------|----------------|---------------|-------------|--------|
|                     |                |               |             |        |
|                     |                |               |             |        |
|                     |                |               |             |        |
|                     |                |               |             |        |
|                     |                |               |             |        |

- E. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.
- F. Upon completion of video tape reviews by Contracting Officer, Contractor will be notified regarding final acceptance of sewer segment.

**END OF SECTION**

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**SANITARY SEWER FORCE MAINS**

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**SECTION 02532**

**SANITARY SEWER FORCE MAINS**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Sanitary sewer forcemains.

**.02 REFERENCE STANDARDS**

- A. ACI 318 - ACI Building Code and Commentary.
- B. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 C and 30 C with a Vitreous Silica Dilatometer.
- C. ASTM D 2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber Reinforced- Thermosetting-Resin) Pipe.
- D. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.
- E. ASTM D 2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.
- F. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Force mains 24 inches in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.
- D. Submit qualifications, proposed methods, equipment, materials, and sequence for acceptance testing of pipeline. Submit evidence of experience with pipeline proving by pigging for at least three projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person, and telephone number. Provide certificate of training by manufacturer of pigging equipment being used.
- E. Submit test reports as specified in Part 3 of this Section.

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**SANITARY SEWER FORCE MAINS****PART 2 PRODUCTS****.01 PIPE FITTING MATERIAL SCHEDULE**

- A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:
1. Section 02501 - Ductile-Iron Pipe and Fittings.
  2. Section 02505 - High Density Polyethylene Solid and Profile Wall Pipe (HDPE).
  3. Section 02506 - Polyvinyl Chloride Pipe. Provide Lined Ductile-Iron Fittings in Accordance with Section 02501 - Ductile-Iron Pipe and Fittings.

**.02 THRUST RESTRAINT**

- A. Unless otherwise shown on Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Concrete for Utility Construction. Place concrete in accordance with details on Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below pipe or fitting to 12 inches above.
- B. For forcemains larger than 12 inches in diameter, and where indicated on Drawings, provide restrained joints conforming to requirements of force main pipe material specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on Drawings.
- C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.
- D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint or blocks as shown on Drawings.
- E. Provide thrust blocks or restraint at tees, plugs, blowoff drains, valves, and caps, as indicated.

**PART 3 EXECUTION****.01 PIPE INSTALLATION BY OPEN-CUT**

- A. Perform excavation, bedding, and backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.
- B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02528 - Polyethylene Wrap. Do not install polyethylene wrap on ductile iron pipe protected by cathodic protection system or fusion bonded or polyurethane coated fittings.

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- C. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- D. Install pipe only after excavation is completed, bottom of trench is fine graded, bedding material is installed, and trench has been approved by Contracting Officer.
- E. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- F. Install pipe with spigot ends toward direction of flow. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- G. Keep interior of pipe clean as installation progresses. Where cleaning after laying pipe is difficult because of small pipe size, use suitable swab or drag in pipe and pull it forward past each joint immediately after joint has been completed. Remove foreign material and debris from pipe.
- H. Provide lubricant, place and drive home newly-laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back - hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Contracting Officer.
- I. Keep excavations free of water during construction and until final inspection.
- J. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- K. Where sanitary sewer force main is to be installed under existing water line with separation distance of less than 2 feet, install one full joint length of pipe, minimum 18 foot length, centered on water line and maintain minimum 6-inch separation distance.

**.02 PIPE INSTALLATION OTHER THAN OPEN-CUT**

- A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification section of augering or tunneling work.

**.03 HYDROSTATIC TESTING**

- A. After pipe and appurtenance have been installed, test line and drain. Prevent damage to Work or adjacent areas. Use clean water to perform tests.
- B. Contracting Officer may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.
- C. Test pipe in presence of Contracting Officer.
- D. Test pipe at 150 psig or 1.5 times design pressure of pipe, whichever is greater. Design pressure of force main shall be rated total dynamic head of lift station pump.

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- E. Test pipe at required pressure for minimum of 2 hours according to requirements of UNI-B-3.
- F. Maximum allowable leakage shall be as calculated by following formula:
$$L = (S) (D) (P^{0.5}) / 133,200$$

Where:

  - L = Leakage in gallons per hour.
  - S = Length of pipe in feet.
  - P = Inside diameter of pipe in inches.
  - D = Pressure in pounds per square inch.
- G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by Contracting Officer.
- H. Plug openings in force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering tested pipeline.

**.04 PIGGING TEST**

- A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.
- B. Pigs: Provide proving pigs manufactured of open-cell polyurethane foam body, without coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of nominal crosssectional area of pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to force main being tested.
- C. Test Execution: Conduct pigging test in presence of Contracting Officer. Provide at least 48 hours notice of scheduled pigging of force main prior to commencing test.

**END OF SECTION**

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**SECTION 02533**

**ACCEPTANCE TESTING FOR SANITARY SEWERS**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Acceptance testing of sanitary sewers including:
  - 1. Visual inspection of sewer pipes
  - 2. Mandrel testing for flexible sewer pipes.
  - 3. Leakage testing of sewer pipes.
  - 4. Leakage testing of manholes.
  - 5. Smoke testing of point repairs.
- B. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

**.02 REFERENCES**

- A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
- B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

**.03 PERFORMANCE REQUIREMENTS**

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.
- B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. Maximum allowable leakage for Infiltration or Exfiltration
  - 1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of



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2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.

2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
3. Refer to Table 02533-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.
- D. Perform air testing in accordance with requirements of this Section and the local state environmental agency requirements. Refer to Table 02533-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 02533-3, Minimum Testing Times for Low Pressure Air Test, and Table 02533-4, Vacuum Test Time Table, at end of this Section.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Contracting Officer. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

**.05 GRAVITY SANITARY SEWER QUALITY ASSURANCE**

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports and video tape of television inspection as directed by Contracting Officer.
- C. Upon completion of tape reviews by Contracting Officer, Contractor will be notified regarding final acceptance of sewer segment.

**.06 SEQUENCING AND SCHEDULING**

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Contracting Officer. Perform testing under observation of Contracting Officer.

**PART 2 PRODUCTS****.01 DEFLECTION MANDREL**

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- A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.
- C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.
- D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02533-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Contracting Officer.

**.02 INFILTRATION TEST**

- A. Water Meter: Obtain transient water meter from Contracting Officer furnished by AW for use when water for testing will be taken from AW system. Conform to AW requirements for water meter use.
- B. Test Equipment:
  - 1. Pipe plugs.
  - 2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

**.03 INFILTRATION TEST**

- A. Test Equipment:
  - 1. Calibrated 90 degree V-notch weir.
  - 2. Pipe plugs.

**.04 LOW PRESSURE AIR TEST**

- A. Minimum Requirement for Equipment:
  - 1. Control panel
  - 2. Low-pressure air supply connected to control panel.
  - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of

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withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:
  - a. Air supply.
  - b. Pneumatic plugs.
  - c. Sealed line for pressuring.
  - d. Sealed line for monitoring internal pressure.

- B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

**.05 GROUND WATER DETERMINATION**

- A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

**.06 SMOKE TESTING**

- A. Equipment:
  1. Pneumatic plugs.
  2. Smoke generator as supplied by Superior Signal Company, or approved equal.
  3. Blowers producing 2500 scfm minimum.

**PART 3 EXECUTION**

**.01 PREPARATION**

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Control of Ground Water and Surface Water.

**.02 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS**

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and relay or replace pipe segment.

**.03 MANDREL TESTING FOR GRAVITY SANITARY SEWERS**

- A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034.

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- Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.
- B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.
- C. Retest repaired or replaced sewer sections.

**.04 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS**

- A. Test Options:
1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
  2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
  3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
  4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.
- B. Compensating for Ground Water Pressure:
1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
  2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.
- C. Exfiltration test:
1. Determine ground water elevation.
  2. Plug sewer in downstream manhole.
  3. Plug incoming pipes in upstream manhole.
  4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
  5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
  6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02533-1 at end of this Section.

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- 
- D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).
1. Determine ground water elevation.
  2. Plug incoming pipes in upstream manhole.
  3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
  4. Allow water to rise and flow over weir until it stabilizes.
  5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 02533-1 at end of this Section.
- E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02533-2.
1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
  2. For pipe sections less than 36-inch average inside diameter:
    - a. Determine ground water level.
    - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
    - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
    - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 02533-2 at end of this Section.
    - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 02533-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- F. Retest: Repair and retest any section of pipe which fails to meet requirements.

**.05 TEST CRITERIA TABLES**

- A. Exfiltration and Infiltration Water Tests: Refer to Table 02533-1, Water Test Allowable Leakage, at end of this Section.
- B. Low Pressure Air Test:
1. Times in Table 02533-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B). If the state where the project is being completed has more stringent times, the local state's requirements will apply.

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|        |     |   |
|--------|-----|---|
|        |     | $T = 0.0850(D)(K)/(Q)$  |
| where: | T = | Time for pressure to drop 1.0 pounds per square inch gauge in seconds |
|        | K = | 0.000419 DL, but not less than 1.0                                    |
|        | D = | Average inside diameter in inches                                     |
|        | L = | Length of line of same pipe size in feet                              |
|        | Q = | Rate of loss, 0.0015 ft <sup>3</sup> /min./sq.ft. internal surface    |

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02533-3, Minimum Testing Times for Low Pressure Air Test.

Notes:

1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

.06 LEAKAGE TESTING FOR MANHOLES

- A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.
- B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.
- C. Vacuum testing:
  1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
  2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 02533-4, Vacuum Test Time Table.

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3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.
- D. Perform hydrostatic exfiltration testing as follows:
  1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
  2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
  3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

**.07 SMOKE TEST PROCEDURE FOR POINT REPAIRS**

- A. Application: Perform smoke test to:
  1. Locate points of line failure for point repair.
  2. Determine when point repairs are properly made.
  3. Determine when service connections have been reconnected to rehabilitated sewer.
  4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.
- B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.
- C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to local police and fire departments 24 hours prior to actual smoke testing.
- D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.
- E. Smoke Introduction:
  1. Operate equipment according to manufacturer's recommendation and as approved by Project Manager.
  2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
  3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.
- F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling

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of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Contracting Officer.

- G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

**TABLE 02533-1**  
WATER TEST ALLOWABLE LEAKAGE

| DIAMETER OF RISER OR STACK<br>IN INCHES                                   | VOLUME PER INCH OF<br>DEPTH |         | ALLOWANCE LEAKAGE*   |                              |
|---|-----------------------------|---------|--|------------------------------|
|   | INCH                        | GALLONS | PIPE SIZE IN<br>INCHES   | GALLONS/MINUTE<br>PER 100FT. |
| 1   | 0.7854                      | .0034   | 6  | 0.0039                       |
| 2   | 3.1416                      | .0136   | 8  | 0.0053                       |
| 2.5   | 4.9087                      | .0212   | 13   | 0.0066                       |
| 3   | 7.0686                      | .0306   | 12   | 0.0079                       |
| 4   | 12.5664                     | .0306   | 15   | 0.0099                       |
| 5   | 19.6350                     | .0544   | 18   | 0.0118                       |
| 6   | 28.2743                     | .1224   | 21   | 0.0138                       |
| 8   | 50.2655                     | .2176   | 24   | 0.0158                       |
|   |                             |         | 27   | 0.0177                       |
|   |                             |         | 30   | 0.0197                       |
|   |                             |         | 36   | 0.0237                       |
|   |                             |         | 42   | 0.0276                       |
| For other diameters, multiply square of diameters by value of 1" diameter |                             |         | Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours |                              |

\* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain



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**TABLE 02533-2**  
ACCEPTANCE TESTING FOR SANITARY SEWERS

| TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG |                           |                                 |                                       |   |        |        |        |        |        |        |        |        |        |        |
|--|---------------------------|---------------------------------|---------------------------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Pipe Dia<br>m.<br>(in)                                   | Min.<br>Time<br>(min:sec) | Length<br>for min.<br>time (ft) | Time for<br>Longer<br>Length<br>(sec) | Specification Time for Length (L) shown (min:sec) |        |        |        |        |        |        |        |        |        |        |
|  |                           |                                 |                                       | 100 ft  | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft | 500 ft | 550 ft | 600 ft |
| 6  | 5:40                      | 398                             | 0.8548                                | 5:40  | 5:40   | 5:40   | 5:40   | 5:40   | 5:40   | 5:42   | 6:25   | 7:07   | 7:50   | 8:33   |
| 8  | 7:33                      | 298                             | 1.5196                                | 7:33  | 7:33   | 7:33   | 7:33   | 7:36   | 8:52   | 10:08  | 11:24  | 12:40  | 13:56  | 15:12  |
| 10   | 9:27                      | 239                             | 2.3742                                | 9:27  | 9:27   | 9:27   | 9:54   | 11:52  | 13:51  | 15:50  | 17:48  | 19:47  | 21:46  | 23:45  |
| 12   | 11:20                     | 199                             | 3.4190                                | 11:20   | 11:20  | 11:20  | 14:15  | 17:06  | 19:57  | 22:48  | 25:39  | 28:30  | 31:20  | 34:11  |
| 15   | 14:10                     | 159                             | 5.3423                                | 14:10   | 14:10  | 17:48  | 22:16  | 26:43  | 31:10  | 35:37  | 40:04  | 44:31  | 48:58  | 53:25  |
| 18   | 17:00                     | 133                             | 7.6928                                | 17:00   | 19:14  | 25:39  | 32:03  | 38:28  | 44:52  | 51:17  | 57:42  | 64:06  | 70:31  | 76:56  |
| 21   | 19:50                     | 114                             | 10.4708                               | 19:50   | 26:11  | 34:54  | 43:38  | 52:21  | 61:05  | 69:48  | 78:32  | 87:15  | 95:59  | 104:42 |
| 24   | 22:40                     | 99                              | 13.6762                               | 22:48   | 34:11  | 45:35  | 56:59  | 68:23  | 79:47  | 91:10  | 102:34 | 113:58 | 125:22 | 136:46 |
| 27   | 25:30                     | 88                              | 17.3089                               | 28:51   | 43:16  | 57:42  | 72:07  | 86:33  | 100:58 | 115:24 | 129:49 | 144:14 | 158:40 | 173:05 |
| 30   | 28:20                     | 80                              | 21.3690                               | 35:37   | 53:25  | 71:14  | 89:02  | 106:51 | 124:39 | 142:28 | 160:16 | 178:05 | 195:53 | 213:41 |
| 33   | 31:10                     | 72                              | 25.8565                               | 43:06   | 64:38  | 86:11  | 107:44 | 129:17 | 150:50 | 172:23 | 193:55 | 215:28 | 237:01 | 258:34 |

**TABLE 02533-3**  
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

| PIPE DIAMETER<br>(inches) | MINIMUM<br>TIME<br>(seconds) | LENGTH FOR<br>MINIMUM TIME<br>(feet) | TIME FOR LONGER<br>LENGTH<br>(seconds) |
|---------------------------|------------------------------|--------------------------------------|--|
| 6                         | 340                          | 398                                  | 0.855 (L)                              |
| 8                         | 454                          | 298                                  | 1.520 (L)                              |
| 10                        | 567                          | 239                                  | 2.374 (L)                              |
| 12                        | 680                          | 199                                  | 3.419 (L)                              |
| 15                        | 850                          | 159                                  | 5.342 (L)                              |
| 18                        | 1020                         | 133                                  | 7.693 (L)                              |
| 21                        | 1190                         | 114                                  | 10.471 (L)                             |
| 24                        | 1360                         | 100                                  | 13.676(L)                              |
| 27                        | 1530                         | 88                                   | 17.309 (L)                             |
| 30                        | 1700                         | 80                                   | 21.369 (L)                             |
| 33                        | 1870                         | 72                                   | 25.856 (L)                             |

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| DEPTH IN FEET   | TIME IN SECONDS BY PIPE DIAMETER |     |     |
|---|----------------------------------|-----|-----|
|   | 48"                              | 60" | 72" |
| 4   | 10                               | 13  | 16  |
| 8   | 20                               | 26  | 32  |
| 12  | 30                               | 39  | 48  |
| 16  | 40                               | 52  | 64  |
| 20  | 50                               | 65  | 80  |
| 24  | 60                               | 78  | 96  |
| *   | 5.0                              | 6.5 | 8.0 |
| <b>*Add T times for each additional 2-foot depth.<br/>(The values listed above have been extrapolated from ASTM C 924-85)</b> |                                  |     |     |

**TABLE 02533-5**  
PIPE VS. MANDREL DIAMETER

| Material and<br><u>Wall Construction</u> | Nominal<br>Size<br>(Inches) | Average<br>I.D<br>(Inches) | Minimum Mandrel<br>Diameter<br>(Inches) |
|--|-----------------------------|----------------------------|---|
| PVC-Solid (SDR 26)6                      | 6                           | 5.764                      | 5.476                                   |
|  | 8                           | 7.715                      | 7.329                                   |
|  | 10                          | 9.646                      | 9.162                                   |
| PVC-Solid (SDR 35)12                     | 12                          | 11.737                     | 11.150                                  |
|  | 15                          | 14.374                     | 13.655                                  |
|  | 18                          | 17.629                     | 16.748                                  |
|  | 21                          | 20.783                     | 19.744                                  |
|  | 24                          | 23.381                     | 22.120                                  |
|  | 27                          | 26.351                     | 25.033                                  |
| PVC-Truss                                | 8                           | 7.750                      | 7.363                                   |
|  | 10                          | 9.750                      | 9.263                                   |
|  | 12                          | 11.790                     | 11.201                                  |
|  | 15                          | 14.770                     | 14.032                                  |
| PVC-Profile (ASTM F 794)                 | 12                          | 11.740                     | 11.153                                  |
|  | 15                          | 14.370                     | 13.652                                  |
|  | 18                          | 17.650                     | 16.768                                  |
|  | 21                          | 20.750                     | 19.713                                  |
|  | 24                          | 23.500                     | 22.325                                  |
|  | 27                          | 26.500                     | 25.175                                  |
|  | 30                          | 29.500                     | 28.025                                  |
|  | 36                          | 35.500                     | 33.725                                  |
|  | 42                          | 41.500                     | 39.425                                  |
|  | 48                          | 47.500                     | 45.125                                  |
| HDPE-Profile                             | 18                          | 18.000                     | 17.100                                  |
|  | 21                          | 21.000                     | 19.950                                  |
|  | 24                          | 24.000                     | 22.800                                  |
|  | 27                          | 27.000                     | 25.650                                  |
|  | 30                          | 30.000                     | 28.500                                  |
|  | 36                          | 36.000                     | 34.200                                  |
|  | 42                          | 42.000                     | 39.900                                  |
|  | 48                          | 48.000                     | 45.600                                  |
|  | 54                          | 54.000                     | 51.300                                  |
|  | 60                          | 60.000                     | 57.000                                  |

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| <b>Material and<br/>Wall Construction</b> | <b>Nominal<br/>Size<br/>(Inches)</b> | <b>Average<br/>I.D<br/>(Inches)</b> | <b>Minimum Mandrel<br/>Diameter<br/>(Inches)</b> |
|---|--------------------------------------|-------------------------------------|--|
| Fiberglass                                | 12                                   | 12.85                               | 11.822   |
| (Class SN 46)                             | 18                                   | 18.66                               | 17.727   |
|   | 20                                   | 20.68                               | 19.646   |
|   | 24                                   | 24.72                               | 23.484   |
|   | 30                                   | 30.68                               | 29.146   |
|   | 36                                   | 36.74                               | 34.903   |
|   | 42                                   | 42.70                               | 40.565   |
|   | 48                                   | 48.76                               | 46.322   |
|   | 54                                   | 54.82                               | 52.079   |
|   | 60                                   | 60.38                               | 57.361   |

**END OF SECTION**

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STUBS OR RECONNECTIONS**

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**SECTION 02534**

**SANITARY SEWER SERVICE STUBS OR RECONNECTIONS**

**PART 1 GENERAL**

**.01 SECTION INCLUDES**

- A. Installation of service stubs in sanitary sewers serving areas where sanitary sewer service did not previously exist.
- B. Reconnection of existing service connections along parallel, replacement, or rehabilitated sanitary sewers.

**.02 REFERENCES**

- A. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- B. ASTM D 3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- C. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

**.03 PERFORMANCE REQUIREMENTS**

- A. Accurately locate in field all proposed service stubs along new sanitary sewer main.
- B. Accurately locate in field existing service connections and proposed service stubs along alignment of new parallel or replacement sewer main.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit product data for each pipe product, fitting, coupling and adapter.
- C. Show reconnected services on record drawings. Give exact distance from each service connection to nearest downstream manhole.

**PART 2 PRODUCTS**

**.01 PVC SERVICE CONNECTION**

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- A. As stub outs, use PVC sewer pipe of 4-inch through 10-inch diameter, conforming to ASTM D 1784 and ASTM D 3034, with cell classification of 12454-B. SDR (ratio of diameter to wall thickness) shall be 26 for pipe 10 inches in diameter or less.
- B. PVC pipe shall be gasket jointed with gasket conforming to ASTM D 3212.
- C. Provide service connection pipe in sizes shown on Drawings. For reconnection of existing services, select service connection pipe diameter to match existing service diameter. Reconnections to rehabilitated sanitary sewer mains shall be limited to following maximum service connection diameter:

| Sewer Diameter | Maximum Service Connection Diameter |
|----------------|-------------------------------------|
| 8" or less     | 4"                                  |
| 10" or less    | 6"                                  |

- D. Subject to above limits, provide 6-inch service connection when more than one service discharges into single pipe.
- E. Connect service pipes to parallel or replacement sewer mains with prefabricated, full-bodied tee or wye fittings conforming to specifications for sewer main pipe material as specified in other Sections for sewers up to 18 inches in diameter.
- F. Where sewers are installed using pipe augering or tunneling, or where sewer is greater than 18 inches in diameter, use Fowler "Inserta-Tee" to connect service to sewer main.

## .02 PIPE SADDLES

- A. Use pipe saddles only on rehabilitated sanitary sewer mains. Comply with Paragraph 2.01E for new parallel and replacement sanitary sewer mains.
- B. Supply one-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket to accomplish complete seal. Use saddle fabricated to fit outside diameter of connecting pipe. Protruding lip of saddle must be at least 5/8-inch long with grooves or ridges to retain stainless steel band clamps.
- C. Use 1/2-inch stainless steel band clamps for securing saddles to liner pipe.

## .03 COUPLINGS AND ADAPTERS

- A. For connections between new PVC pipe stubouts and existing service, 4-, 6-, or 8-inch diameter, use flexible adapter coupling consisting of neoprene gasket and stainless steel shear rings with 1/2-inch stainless steel band clamps:
  1. Fernco Pipe Connectors, Inc. Series 1055 with shear ring SR-8
  2. Band Seal by Mission Rubber Co., Inc.
  3. Approved equal.

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- B. For connections between new PVC pipe stubout and new service, use rubber-gasket adapter coupling:
  - 1. GPK Products, Inc.
  - 2. IPS & Sewer Adapter
  - 3. Approved equal.

**.04 STACKS**

- A. Provide stacks for service connections wherever crown of sewer is 8 feet or more below finished grade.
- B. Construct stacks of same material as sanitary sewer and as shown on Drawings.
- C. Provide stacks of same nominal diameter at sanitary service line.

**.05 PLUGS AND CAPS**

- A. Seal upstream end of unconnected sewer service stubs with rubber gasket plugs or caps of same pipe type and size. Provide plugs or caps by GPK Products, Inc., or approved equal.

**PART 3 EXECUTION**

**.01 PERFORMANCE REQUIREMENTS**

- A. Provide minimum of 72 hours notice to customers whose sanitary sewer service will potentially be interrupted.
- B. Accurately field locate service connections, whether in service or not, along rehabilitated sanitary sewer main. For parallel and replacement sewers, service connections may be located as pipe laying progresses from downstream to upstream.
- C. Properly disconnect existing connections from sewer and reconnect to rehabilitated liner, as described in this Section.
- D. Reconnect service connections, including those that go to unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by Contracting Officer.
- E. Complete reconnection of service lines within 24 hours after cured-in-place liner installation and within 72 hours after disconnection for sliplining, parallel, or replacement sanitary sewer mains.
- F. Reconnect services on cured-in-place liner at 12 feet depth or less by excavation method. Contracting Officer reserves right to require service connections by excavation when remote cut service connection damages lines.
- G. Reconnection by excavation method shall include stack and fittings and required pipe length to reconnect service line.

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- H. Connect services 8 inches in diameter and larger to sewer by construction of manhole. Refer to appropriate Section on manholes for construction.

.02 PROTECTION

- A. Provide barricades, warning lights, and signs for excavations created for service connections.
- B. Do not allow sand, debris, or runoff to enter sewer system.

.03 PREPARATION

- A. Determine existing sewer locations and number of existing service connections from closedcircuit television (CCTV) inspection tapes or from field survey. Accurately field locate existing service connections, whether in service or not. Use existing service locations to connect or reconnect service lines or liner.
- B. For rehabilitated sanitary sewer mains, allow liner to normalize to ambient temperature and recover from imposed stretch. For cured-in-place liners, verify that liner is completely cured.
- C. For new parallel and replacement sanitary sewer mains, complete testing and acceptance of downstream sewers as applicable. Provide for compliance with requirements of Paragraph 3.01E.

.04 EXCAVATION AND BACKFILL

- A. Excavate in accordance with Section 02317 - Excavation and Backfill for Utilities.
- B. Perform work in accordance with OSHA standards. Employ Trench Safety System as specified in Section 02260 - Trench Safety System for excavations requiring trench safety.
- C. Install and operate necessary ground water and surface water control measures in accordance with requirements of the contract documents.
- D. Determine locations where limited access, buildings or structure preclude use of mechanical excavation equipment. Obtain approval from Contracting Officer for hand excavation.

.05 RECONNECTION BY EXCAVATION METHOD

- A. Remove portion of existing sanitary sewer main or carrier pipe to expose liner pipe. Provide sufficient working space for installing prefabricated pipe saddle.
- B. Carefully cut liner pipe making hole to accept stubout protruding from underside of saddle.
- C. Strap on saddle using stainless steel band on each side of saddle. Tighten bands to produce watertight seal of saddle gasket to liner pipe.

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- D. Remove and replace cracked, offset, or leaking service line for up to 5 feet, measured horizontally, from center of new liner.
- E. Make up connection between liner and service line using PVC sewer pipe and approved fittings and couplings.
- F. Test service connections before backfilling.

**.06 RECONNECTION BY REMOTE METHOD**

- A. Make service reconnections using remote-operated cutting tools on cured-in-place liners at depth greater than 12 feet.
- B. Employ method and equipment that restore service connection capacity to not less than 90 percent of original capacity.
- C. Immediately open missed connections and repair holes drilled in error using method approved by Contracting Officer.

**.07 RECONNECTION ON PARALLEL OR REPLACEMENT SEGMENTS**

- A. Install service connections on sewer main.
- B. Remove and replace cracked, offset or leaking service line for up to 5 feet, measured horizontally, from centerline of sanitary sewer main.
- C. Make up connection between main and existing service line using PVC sewer pipe and approved couplings, as shown on Drawings.
- D. Test service connections before backfilling.
- E. Embed service connection and service line as specified for sanitary sewer main as shown on Drawings. Place and compact trench zone backfill in compliance with Section 02317 - Excavation and Backfill for Utilities.

**.08 INSTALLATION OF NEW SERVICE STUBS**

- A. Install service connections on sanitary sewer main for each service connection. Provide length of stub indicated on Drawings. Install plug or cap on upstream end of service stub as needed.
- B. Test service connections before backfilling.
- C. Embed service connection and service line as specified for sanitary sewer main, and as shown on Drawings. Place and compact trench zone backfill in compliance with Section 02317 - Excavation and Backfill for Utilities. Install minimum 2-foot length of magnetic locating tape along axis of service stub and 9 inches to 12 inches above crown of pipe, at end of stub.

**.09 TESTING**



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- A. Test service reconnections and service stubs. Follow applicable procedures given in Section 02533 - Acceptance Testing for Sanitary Sewers to perform smoke testing to confirm reconnection.
- B. Perform post installation CCTV inspection as specified in the contract documents. Cleaning and Television Inspection to show locations of service connection.

.010 CLEANUP

- A. Backfill excavation as specified in Section 02317 - Excavation and Backfill for Utilities.
- B. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02951 - Pavement Repair and Resurfacing. In unpaved areas, bring surface to grade and slope surrounding excavation. Replace minimum of 4 inches of topsoil and seed according to requirements of Section 02921 - Hydro-mulch Seeding.

**END OF SECTION**

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**SECTION 02621****GEOTEXTILE****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Geotextile, also called filter fabric, in applications including pipe embedment wrap, around exterior of tunnel liner, around foundations of pipeline structures, and slope stabilization.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for Work performed under this Section. Include cost of Work in unit prices for Work requiring geotextile.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. AASHTO M 288 - Standard Specification for Geotextile Specification for Highway Applications.
- B. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- C. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- D. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab Method).
- E. ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of Geotextiles.
- F. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit standard manufacturer's catalog sheets and other pertinent information, for approval, prior to installation.

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- C. Submit installation methods, as part of Work plan for tunneling or for excavation and backfill for utilities. Obtain approval from Project Manager for filter fabric material and proposed installation method prior to use of filter fabric.

**PART 2 PRODUCTS**

**.01 GEOTEXTILE**

- A. Provide geotextile (filter fabric) designed for use in geotechnical applications. Filter fabric shall provide permeable layer or media while retaining soil matrix.
- B. Use fabric which meets physical requirements for Class A subsurface drainage installation conditions as defined in AASHTO M 288 and as specified in Paragraph 2.02, Properties.

**.02 PROPERTIES**

- A. Material: Nonwoven, nonbiodegradable, fabric consisting of continuous chain polymer filaments or yarns, at least 85 percent by weight polyolefins, polyesters or polyamide, formed into dimensionally stable network.
- B. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over pH range of 3 to 12.
- C. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.
- D. Minimum Test Values:

| Property                                 | Value (Min) | Test Method |
|--|-------------|-------------|
| Grab Strength                            | 180 lbs.    | ASTM D 4632 |
| Trapezoidal tear Strength                | 50 lbs.     | ASTM D 4533 |
| Puncture Strength                        | 80 lbs.     | ASTM D 4833 |
| Mullen Burst Strength                    | 290 psi.    | ASTM D 3786 |
| Apparent Opening Size <sup>1</sup>       | 0.25 mm     | ASTM D 4751 |
| Permittivity (sec <sup>-1</sup> )        | 0.2         | ASTM D 4491 |
| <sup>1</sup> Maximum average roll value. |             |             |

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**PART 3 EXECUTION**

.01 LINE WORK

- A. Conform use of geotextile to backfill for utilities to Section 02317 -  
Excavation and Backfill for Utilities.

.02 TUNNEL WORK

- A. Use geotextile outside of tunnel primary liner to prevent migration of soil  
fines into excavated tunnel resulting in voids or settlement. Select  
geotextile, subject to minimum requirements of Paragraph 2.02, meeting  
tunnel liner design requirements and installation conditions.

**END OF SECTION**

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**SECTION 02711****HOT MIX ASPHALT BASE COURSE****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Foundation course of compacted mixture of coarse and fine aggregates, and asphalt binder.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for hot mix asphalt base is on a per ton basis.
  - 2. Payment for hot mix asphalt base for transitions and base repairs is on a per ton basis.
  - 3. Payment for hot mix asphaltic base for temporary driveway, roadway shoulders, etc., is on a per ton basis.
  - 4. Measurement for utility projects:
    - a. Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
    - b. Include installed hot mix asphalt base course material that extends one foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common edge with existing pavement section.
  - 5. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. AASHTO T201 - Standard Specification for Kinematic Viscosity of Asphalts (Bitumens).
- B. AASHTO T202 - Standard Specification for Viscosity of Asphalt by Vacuum Capillary Viscometer.
- C. ASTM C 33 - Standard Specifications for Concrete Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

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- F. ASTM D 4402 - Standard Test Method for Viscosity Determination of unfilled Asphalt Using the Brookfield Thermal Apparatus.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
- C. Submit proposed mix and test data for each type of base course in Work.
- D. Submit manufacturer's description and characteristics of mixing plant for approval.
- E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Coarse Aggregate:
1. Use crushed gravel or crushed stone, or combination retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious material occurring either free or as coating on aggregate. Conform aggregate to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
  2. Reclaimed asphalt pavement (RAP) or reclaimed Portland cement concrete pavement (RPCCP) are permitted as aggregates for hot mix asphalt base course if combined aggregate criteria, gradation, and mixture properties are met.
- B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Conform aggregate to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other deleterious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested. Sand equivalent shall have minimum value of 45 when tested.
- C. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C 136. Provide either coarse or fine aggregate where designated on the Drawings.

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| <b>GRADATION OF COMPOSITE AGGREGATE</b>     |                    |                  |
|---|--------------------|------------------|
| <b>Percent Passing by Weight or Volume</b>  |                    |                  |
| Sieve Size                                  | Type A Coarse Base | Type B Fine Base |
| 1 ½"  | 100                | -                |
| 1 ¼"  | 95 to 100          | -                |
| 1"  | -                  | 100              |
| 7/8"  | 70 to 90           | 95 to 100        |
| 5/8"  | -                  | 75 to 95         |
| ½"  | 50 to 70           |                  |
| 3/8"  | -                  | 60 to 80         |
| #4  | 30 to 50           | 40 to 60         |
| #10   | 30 to 34           | 27 to 40         |
| #40   | 5 to 20            | 10 to 25         |
| #80   | 2 to 12            | 3 to 13          |
| #200  | 1 to 6*            | 1 to 6*          |
| VMA % Minimum                               | 11                 | 12               |
| *2 to 8 when Washed Sieve Analysis is used. |                    |                  |

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- D. Asphalt Binder: Moisture-free homogeneous material meeting following requirements: <sup>a.</sup>

| SPECIFICATION  | PG 64 - 22 |
|--|------------|
| Average 7-day Maximum Pavement Design Temperature, degrees C <sup>a.</sup>   | <64        |
| Minimum Pavement Design Temperature, degrees C <sup>a.</sup>   | >-22       |
| Original Binder  |            |
| Flash Point Temperature, T48, Minimum degrees C  | 230        |
| Viscosity, ASTM D 4402, <sup>b.</sup> Maximum 3 Pa.s (3000cP), Test Temperature, degrees C   | 135        |
| Dynamic Shear, TP5; <sup>c.</sup> G*/sine[], Minimum, 1.00kPa Test Temperature @ 10 rad/sec, degrees C   | 64         |
| Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue   |            |
| Mass Loss, Maximum, %  | -1.00      |
| Dynamic Shear, TP5; G*/sine[], Minimum, 2.20 kPa Test Temperature @ 10rad/sec, degrees C   | 64         |
| Pressure Aging Vessel Residue (PPI)  |            |
| PAV Aging Temperature, degrees C <sup>d.</sup>   | 100        |
| Dynamic Shear, TP5; G*/sine[], Maximum, 5000kPa Test Temperature @ 10rad/sec, degrees C  | 25         |
| Physical Hardening <sup>e.</sup>   | Report     |
| Creep Stiffness, TP1; <sup>f.</sup> S, Maximum, 300 Mpa; m-value, Minimum, 0.300 Test Temperature @ 60sec, degrees C   | -12        |
| Direct Tension, TP3; <sup>f.</sup> Failure Strain, Minimum, 1.0%; Test Temperature @ 1.0 mm/min, degrees C   | -12        |
| <p>Notes:</p> <p>a. Pavement temperature can be estimated from air temperatures using algorithm contained in testing procedures.</p> <p>b. The requirement may be waived at discretion of Project Manager if supplier warrants that asphalt binder can be adequately pumped and mixed at temperatures that meet applicable safety standards.</p> <p>c. For quality control of unmodified asphalt cement production, measurement of viscosity of original asphalt cement may be substituted for dynamic shear measurements of G*/sine [ ] at test temperature where asphalt is Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometry (AASHTO T 201 or T202).</p> <p>d. The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90 C, 100 C, or 110 C. The PAV aging temperature is 100 C for PG64 and PG70.</p> <p>e. Physical Hardening - TP I is performed on a set of asphalt beams according to Section 13.1, except conditioning time is extended to 24 hours plus or minus 10 minutes at 10 C above minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.</p> <p>f. If creep stiffness is below 300 MPa, the direct tension test is not required. If creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of creep stiffness requirement. The m-value requirement must be satisfied in both cases.</p> |            |



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- E. Reclaimed asphalt pavement (RAP) may be used at a rate no greater than 20 percent.

.02 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, the plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
1. Cold aggregate bins and proportioning device
  2. Dryer
  3. Screens
  4. Aggregate weight box and batching scales
  5. Mixer
  6. Asphalt storage and heating devices
  7. Asphalt measuring devices
  8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. One cold feed bin per stockpile is required.

.03 MIXES

- A. Employ certified testing laboratory to prepare design mixes.
1. Verify mixture design properties for plant-produced mixture. Demonstrate that asphalt plant is capable of producing mixture meeting design volumetric and stability requirements before placement begins.
- B. Density, Stability, and Air Voids Requirements. Select asphalt binder content for base courses to result in 3 to 5 percent air voids in laboratory molded specimens, while meeting minimum VMA requirement for selected mixture classification.

| Percent Density |            | Percent        | HVEEM Stability<br>Percent | Percent Asphalt<br>Content |             |
|-----------------|------------|----------------|----------------------------|----------------------------|-------------|
| <u>Min</u>      | <u>Max</u> | <u>Optimum</u> | Not Less Than              | <u>Min.</u>                | <u>Max.</u> |
| 94.5            | 97.5       | 96             | 35                         | 3.5                        | 7           |

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**PART 3 EXECUTION****.01 PREPARATION**

- A. Complete backfill of new utilities below future grade.
- B. Verify lines and grades are correct.
- C. Prepare subgrade in accordance with requirements of Section 02315 - Roadway Excavation. Subgrade preparation may also refer to Section 02321 - Cement Stabilized Sand.
- D. Correct subgrade deviations in excess of plus or minus 1/4 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

**.02 PLACEMENT**

- A. Place base when surface temperature taken in shade and away from artificial heat is above 40 degrees F and rising. Do not place asphalt base when temperature of surface to receive base course is below 50 degrees F and falling.
- B. Haul prepared and heated asphalt base mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.
- C. Place hot mix asphalt base course in compacted lifts no greater than 4 inches thick, unless permitted in writing by Engineer.
- D. Place courses as nearly continuously as possible. Place material with approved mechanical spreading and finishing machine of screeding or tamping type. Spread lifts to attain smooth course of uniform density to section, line, and grades as indicated on Drawings.
- E. In areas with limited space where use of paver or front-end loader is impractical, spread by hand and compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix; do not broadcast material. Remove lumps that do not break down readily.

**.03 JOINTS**

- A. Transverse Joints. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back placed material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- B. Existing pavement. When new asphalt is laid against existing asphalt pavement, saw cut existing asphalt to full depth creating vertical face. Clean joint and apply tack coat before placement.

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.04 COMPACTION

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids. Prepare test strip at least 500 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair line cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water; do not use petroleum by-products.
- C. Compact surface thoroughly and uniformly with power-driven equipment capable of obtaining required compaction. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 175 degrees F.
- D. Along walls, curbs, headers, similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- E. Compact base course to a minimum density of 91 percent.

.05 TOLERANCES

- A. Pavement Repairs.
  - 1. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/4 inch.
  - 2. Completed surface, when tested with 10 foot straight edge laid parallel to center line of pavement, shall show no deviation in excess of 1/4 inch in 10 feet. Correct surface not meeting this requirement.

.06 FIELD QUALITY CONTROL

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, the AW Project Manager may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples

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at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de-sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.

- C. Determine in-place density from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by AW Project Manager.
- D. Request, at option, three additional cores within a 5-foot radius of core indicating nonconforming in-place depth at no additional cost to AW. In-place depth at these locations shall be average depth of four cores.
- E. Fill cores and density test sections with new compacted asphalt base or cold patch material.

**.07 NONCONFORMING PAVEMENT**

- A. Re-compact and retest nonconforming street sections not meeting surface test requirements. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the AW.
- B. Remove and replace areas of asphalt base found deficient in thickness by more than 10 percent. Remove and replace areas of asphalt base found deficient in density. Use new asphalt base of thickness shown on Drawings.
- C. Replace or correct nonconforming pavement sections at no additional cost to AW.

**.08 PROTECTION**

- A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Drawings.
- B. Maintain asphalt base in good condition until completion of Work.
- C. Repair defects immediately by replacing base to full depth.

**END OF SECTION**

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STANDARD SPECIFICATION****CEMENT STABILIZED BASE COURSE**

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**SECTION 02712****CEMENT STABILIZED BASE COURSE****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Foundation course of cement stabilized crushed stone.
- B. Foundation course of cement stabilized bank run gravel.

**.02 MEASUREMENT AND PAYMENT**

- 1. Payment for cement stabilized base course is on square yard basis. Separate pay items are used for each different required thickness of base course.
- 2. Payment for asphaltic seal cure is by gallon.
- 3. Refer to Measurement and Payment for unit price procedures.
- 4. Refer to Paragraph 3.09, Unit Price Adjustment.
- C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in Los Angeles Machine.
- B. ASTM C 150 - Standard Specification for Portland Cement.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600kN kN-m/m<sup>3</sup>).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- E. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit samples of crushed stone, gravel, and soil binder for testing.

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- C. Submit manufacturer's description and characteristics for pug mill and associated equipment, spreading machine, and compaction equipment for approval.

**.05 TESTS**

- A. Perform testing under provisions of Testing Laboratory Services.
- B. Perform tests and analysis of aggregate and binder materials in accordance with ASTM D 1557 and ASTM D 4318.

**.06 DELIVERY, STORAGE AND HANDLING**

- A. Make stockpiles from layers of processed aggregate to eliminate segregation of materials. Load material by making successive vertical cuts through entire depth of stockpile.
- B. Store cement in weatherproof enclosures. Protect from ground dampness.

**PART2 PRODUCTS****.01 CEMENT**

- A. ASTM C 150 Type I; bulk or sacked.

**.02 WATER**

- A. Clean, clear; and free from oil, acids, alkali, or vegetable matter.

**.03 AGGREGATE**

- A. Crushed Stone: Material retained on No. 40 Sieve meeting following requirements:
  - 1. Durable particles of crusher-run broken limestone, sandstone, or granite obtained from approved source.
  - 2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C 131.
- B. Gravel: Durable particles of bank run gravel or processed material.
- C. Soil Binder: Material passing No. 40 Sieve meeting following requirements when tested in accordance with ASTM D 4318:
  - 1. Maximum Liquid limit: 35.
  - 2. Maximum Plasticity index: 10.
- D. Mixed aggregate and soil binder shall meet the following requirements:
  - 1. Grading in accordance within the following limits:

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| Sieve    | Percent Retained |               |           |                 |
|----------|------------------|---------------|-----------|-----------------|
|          | Crushed Stone    | Processed G.1 | Gravel G2 | Bank run Gravel |
| 1 ¾ inch | 0 to 10          | 0 to 5        | -         | 0 to 5          |
| ½ inch   | -                | -             | 0         | -               |
| No.4     | 45 to 75         | 30 to 75      | 15 to 35  | 30 to 75        |
| No.40    | 55 to 80         | 60 to 85      | 55 to 85  | 65 to 85        |

2. Obtain prior permission from AW Project Manager for use of additives to meet above requirements.

.04 ASPHALT SEAL CURE

- A. Cutback Asphalt: MC30
- B. Emulsified Petroleum Resin: EPR-1 Prime

.05 MATERIAL MIX

- A. Design mix for minimum average compressive strength of 200 psi at 48 hours. Provide minimum cement content of 1 1/2 sacks, weighing 94 pounds each, per ton of mix.
- B. Increase cement content when average compressive strength of tests on field samples fall below 200 psi. Refer to Part 3 concerning field samples and tests.
- C. Mix in stationary pug mill equipped with feeding and metering devices for adding specified quantities of base material, cement, and water into mixer. Dry mix base material and cement sufficiently to prevent cement balls from forming when water is added.
- D. Resulting mixture shall be homogeneous and uniform in appearance.

.06 SOURCE QUALITY CONTROL

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, the AW Project Manager may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. Perform testing for unconfined compressive strength as follows:
  1. Mold three samples each day or for each 300 tons of production.
  2. Compressive strength shall be average of three tests for each production lot.

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**PART 3 EXECUTION****.01 EXAMINATION**

- A. Verify compacted subgrade is ready to support imposed loads.
- B. Verify lines and grades are correct.

**.02 PREPARATION**

- A. Complete backfill of new utilities below future grade.
- B. Prepare subgrade in accordance with requirements of Section 02315 - Roadway Excavation.
- C. Correct subgrade deviations in excess of plus or minus 1/4 inch in cross section or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
- D. Prepare sufficient subgrade in advance of base course for efficient operations.

**.03 PLACEMENT**

- A. Do not mix and place cement stabilized base when temperature is below 40 degrees F and falling. Place base when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.
- B. Place material on prepared subgrade in uniform layers to produce thickness indicated on Drawings. Depth of layers shall not exceed 6 inches.
- C. Spread with approved spreading machine. Conduct spreading so as to eliminate planes of weakness or pockets of non-uniformly graded material resulting from hauling and dumping operations.
- D. Provide construction joints between new material and stabilized base that has been in place 4 hours or longer. Joints shall be approximately vertical. Form joint with temporary header or make vertical cut of previous base immediately before placing subsequent base.
- E. Use only one longitudinal joint at center line under main lanes and shoulder unless shown otherwise on Drawings. Do not use longitudinal joints under frontage roads and ramps unless indicated on Drawings.
- F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure firm bond between reinforcement and base.

**.04 COMPACTION**

- A. Start compaction as soon as possible but not more than 60 minutes from start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow stabilized base to mix with underlying material.



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- B. Correct irregularities or weak spots immediately by replacing material and recompact.
- C. Apply water to maintain moisture between optimum and 2 percent above optimum moisture as determined by ASTM D 698. Mix in with spiked tooth harrow or equal. Reshape surface and lightly scarify to loosen imprints made by equipment.
- D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers which are sufficiently light to prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.
- F. Compact to minimum density of 95 percent of maximum dry density at moisture content of treated material between optimum and 2 percent above optimum as determined by ASTM D 1557, unless otherwise indicated on Drawings.
- G. Maintain surface to required lines and grades throughout operation.

**.05 CURING**

- A. Moist cure for minimum of 7 days before adding pavement courses. Restrict traffic on base to local property access. Keep subgrade surface damp by sprinkling.
- B. If indicated on Drawings, cover base surface with curing membrane as soon as finishing operation is complete. Apply with approved self-propelled pressure distributor at following rates, or as indicated on Drawings:
  - 1. MC30: 0.1 gallon per square yard.
  - 2. EPR-1 Prime: 0.15 gallon per square yard.
- C. Do not use cutback asphalt during period of April 16 to September 15

**.06 TOLERANCES**

- A. Smooth and conform completed surface to typical section and established lines and grades.
- B. Top surface of base course: Plus or minus 1 1/4 inch in cross section, or in 16 foot length.

**.07 FIELD QUALITY CONTROL**

- A. Take minimum of one core at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- B. Request additional cores in vicinity of cores indicating nonconforming in-place depths at no extra cost to AW. When average of tests fall below required depth, place additional material and compact at no additional cost to AW.

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- C. Perform compaction testing in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017 at randomly selected locations. Remove and replace areas that do not conform to compaction requirements at no additional cost to AW.
- D. Fill cores and density test sections with new compacted cement stabilized base.

.08 NON CONFORMING BASE COURSE

- A. Remove and replace areas of base course found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with cement-stabilized base of thickness shown on Drawings.
- B. Replace nonconforming base course sections at no additional cost to AW.

.09 UNIT PRICE ADJUSTMENT

- A. Make unit price adjustments for in-place depth determined by cores as follows:
  - 1. Adjusted unit price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
  - 2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.

.010 PROTECTION

- A. Maintain stabilized base in good condition until completion of Work. Repair defects immediately by replacing base to full depth.
- B. Protect asphalt membrane, when used, from being picked up by traffic. Membrane may remain in place when proposed surface courses or other base courses are to be applied.

**END OF SECTION**

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**SECTION 02741****ASPHALTIC CONCRETE PAVEMENT****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Surface course of compacted mixture of coarse and fine aggregates and asphaltic binder.

**.02 MEASUREMENT AND PAYMENT****A. Unit Prices.**

1. Payment for hot-mix asphalt concrete pavement is on a per ton basis. Separate pay items are used for each different required thickness of pavement.
2. Payment for hot-mix asphalt concrete pavement includes payment for associated work performed.
3. Measurement for utility projects: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
4. Payment for temporary detour pavement is on a square yard basis and includes surface and base materials, associated grading, maintenance and removal as well as restoration of ditches .
5. Payment for speed bumps is on linear foot basis, and includes milling of existing pavement, tack coat, and placement and compaction of asphalt. Measurement of speed bump is along length of 12 foot wide speed hump, measured transverse to centerline of road. Separate payment is made for thermoplastic markings applied to speed bump.
6. Refer to Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM C 33 - Standard Specification for Concrete Aggregates.
- B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certificates that asphalt materials and aggregates meet requirements of

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Paragraph 2.01, Materials.

- C. Submit proposed design mix and test data for surface course.
- D. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Coarse Aggregate:
  - 1. Use gravel, crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Use aggregate conforming to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
  - 2. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay-like particles, or silt.
- B. Fine Aggregate: Sand, stone screenings or combination of both passing No. 10 sieve. Use aggregate conforming to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from foams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6. Sand equivalent shall have minimum value of 45.
- C. Composite Aggregate: Conform to following limits. Use type specified on Drawings:

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| GRADATION OF COMPOSITE AGGREGATE             |                         |                       |
|--|-------------------------|-----------------------|
|  | PERCENT PASSING         |                       |
| SIEVE SIZE                                   | Course Surface (Type C) | Fine Surface (Type D) |
| 7/8"   | 100                     | ---                   |
| 5/8"   | 95 to 100               |                       |
| 1/2"   | --                      | 100                   |
| 3/8"   | 70 to 85                | 85 to 100             |
| # 4  | 43 to 63                | 50 to 70              |
| #10  | 30 to 40                | 32 to 42              |
| #40  | 10 to 25                | 11 to 26              |
| #80  | 3 to 13                 | 4 to 14               |
| #200   | 1 to 6*                 | 1 to 6*               |
| VMA % minimum                                | 13                      | 14                    |
| * 2 to 8 when Washed Sieve Analysis is used. |                         |                       |

- D. Asphalt Binder: Moisture-free homogeneous material which will not foam when heated to 347 F, meeting the following requirements.

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| PERFORMANCE GRADED BINDER   |                             |
|---|-----------------------------|
| CRITERIA I TEST   | PERFORMANCE GRADE (PG64-22) |
| Average 7-day Maximum Pavement Design Temperature, C  | < 64                        |
| Minimum Pavement Design Temperature, C  | > -22                       |
| ORIGINAL BINDER   |                             |
| Flash Point Temperature, T48; Minimum C   | 230                         |
| Viscosity, ASTM D 4402; Maximum, 3Pa*s (3000 cP)<br>Test Temperature, C                           | 135                         |
| Dynamic Shear, TP5; $G^*/\sin[\ ]$ , Minimum, 1.00 kPa Test<br>Temperature @ 10 rad/sec., C       | 64                          |
| ROLLING THIN FILM OVEN (T240) OR THIN FILM OVEN (T179) RESIDUE                                    |                             |
| Mass Loss, Maximum , %  | 1.00                        |
| Dynamic Shear, TP5; $G^*/\sin[\ ]$ , Minimum, 2.20 kPa Test<br>Temperature @ 10 rad/sec., C       | 64                          |
| PRESSURE AGING VESSEL RESIDUE (PP1)   |                             |
| PAV Aging Temperature, C  | 100                         |
| Dynamic Shear, TP5; $G^*/\sin[\ ]$ , Minimum, 5000 kPa Test<br>Temperature @ 10 rad/sec., C       | 25                          |
| Physical hardening  | Report                      |
| Creep Stiffness, TP1; S, Maximum, 300 Mpa -value,<br>Minimum, 0.300 Test Temperature @ 60 sec., C | -12                         |
| Direct Tension, TP3; Failure Strain, Minimum, 1.0% Test<br>Temperature @ 1.0 mm/min, C            | -12                         |

E. Anti-stripping Agent:

1. Evaluate mixture of aggregate, asphalt, and additives proposed for use for moisture susceptibility and requirement for anti-stripping agents. To substantiate mix design, produce and test trial mixtures using proposed project materials and equipment prior to placement. Test for susceptibility to moisture and trial mixture may be waived by Project Manager when similar designs using same material have previously proven satisfactory.
2. Liquid Anti-stripping Agent. Use anti-stripping agent with uniform liquid with

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no evidence of crystallization, settling, or separation of components. Submit sample of anti-stripping agent proposed for use and manufacturer's product data, including recommended dosage range, handling and storage, and application instructions.

- F. Pavement markings for speed bumps: Provide 'Thermoplastic Pavement Markings' to match existing or a type as approved by the Project Manager.

.02 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
1. Cold aggregate bins and proportioning device
  2. Dryer
  3. Screens
  4. Aggregate weight box and hatching scales
  5. Mixer
  6. Asphalt storage and heating devices
  7. Asphalt measuring devices
  8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. Provide one cold feed bin per stockpile.

.03 MIXES

- A. Employ certified testing laboratory to prepare design mixes.
- B. Density, Stability and Air Void Requirements:

| Percent Density |            | Percent        | HVEEM Stability<br>Percent |
|-----------------|------------|----------------|----------------------------|
| <u>Min</u>      | <u>Max</u> | <u>Optimum</u> | <u>Not Less Than</u>       |
| 94.5            | 97.5       | 96             | 35                         |

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**PART 3 EXECUTION****.01 EXAMINATION**

- A. Verify compacted base course is ready to support imposed loads.
- B. Verify lines and grades are correct.

**.02 PREPARATION**

- A. Where mixture will adhere to surface on which it is to be placed without use of tack coat, tack coat may be eliminated when approved by Project Manager.
- B. Prepare subgrade in accordance with requirements of Section 02711 - Hot Mix Asphalt Base Course, Section 02712 - Cement Stabilized Base Course.
- C. Prepare subgrade in advance of asphalt concrete paving operation.
- D. Perform pavement repair and resurfacing as indicated in Section 02951 - Pavement Repair and Resurfacing.
- E. Do not use cutback asphalt.
- F. Milling of pavement for speed humps: Mill pavement (concrete or asphalt) to depth of one inch and width between 18 and 24 inches around entire perimeter of proposed hump, as shown in detail for speed hump design.

**.03 PLACEMENT**

- A. Do not place asphalt pavement less than 2 inches thick when surface temperature taken in shade and away from artificial heat is below 50 degrees F and falling. Asphalt may be placed when temperature is above 40 degrees F and rising.
- B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture temperature shall be between 250 degrees F and 325 degrees F when laid.
- C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.
- D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such a manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Place construction joints on surface courses to coincide with lane lines or as directed by Project Manager.
- E. Joints: Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- F. When new asphalt is laid against existing or old asphalt, saw cut existing or old asphalt to full depth to provide straight smooth joint.



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- G. In smaller restricted areas where use of paver is impractical spread material by hand. Compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove lumps that do not break down readily.

**.04 COMPACTION**

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids when directed by the Project Manager. Prepare test strip at least 1,000 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without shoving, displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water or petroleum by-products.
- C. Compact surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing a minimum of 8 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 185 degrees F.
- D. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.
- E. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- F. Compact binder course and surface course to a minimum density of 91 percent of maximum possible density of void less mixture composed of same materials in like proportions.

**.05 TOLERANCES**

- A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 118 inch.
- B. Completed surface, when tested with 10 foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 118 inch in 10 feet. Correct surface not meeting this requirement.
- C. Dimensions of speed humps shall conform to details for speed hump design and speed hump height tolerances.

**.06 QUALITY CONTROL**

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing

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Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, the AW Project Manager may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.

- B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.
- C. Determine in-place density from cores or sections. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Project Manager. Average densities for each street placed in a single day to determine compliance.

**END OF SECTION**

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**SECTION 02751****CONCRETE PAVING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Portland cement concrete paving.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.

1. Payment for concrete paving is on square yard basis. Separate pay items are used for each different required thickness of pavement.
2. Payment for concrete paving, high early strength, is on square yard basis.
3. Measurement for utility projects: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
4. Refer to Measurement and Payment for unit price procedures.
5. Refer to Paragraph 3.15, Unit Price Adjustment.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- B. ASTM A 185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
- D. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- E. ASTM C 33 - Standard Specifications for Concrete Aggregates. 02751-1
- F. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- G. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- H. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

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- I. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
- J. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- K. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- L. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- M. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- N. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- O. ASTM C 150 - Standard Specification for Portland Cement.
- P. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- Q. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- S. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- T. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

.04 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittal Procedures
- B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by AW Project Manager.

.05 HANDLING AND STORAGE

- A. Do not mix different classes of aggregate without written permission of AW Project Manager.
- B. Class of aggregate being used may be changed before or during Work with written permission of Project Manager. Comply new class with specifications.
- C. Reject segregated aggregate. Before using aggregate whose particles are

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separated by size, mix them uniformly to grading requirements.

- D. Reject aggregates mixed with dirt, weeds, or foreign matter.
- E. Do not dump or store aggregate in roadbed.

**PART 2 PRODUCTS**

**.01 MATERIALS**

- A. Portland Cement:
  - 1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
  - 2. Bulk cement which meets referenced standards may be used when method of handling is approved by AW Project Manager. When using bulk cement, provide satisfactory weighing devices.
  - 3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by AW Project Manager.
- B. Water: Conform to requirements for water in ASTM C 94.
- C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).
  - 1. Maximum percentage by weight of deleterious substances shall not exceed following values:

| Item  | <u>Percent by Weight of</u><br><u>Total Sample</u><br>Maximum |
|---|---|
| Clay lumps and friable particles                      | 3.0   |
| Material finer than 75-μm (No. 200) sieve:            |   |
| Concrete subject to abrasion                          | 3.0*  |
| All Other concrete                                    | 5.0*  |
| Coal and lignite:                                     |   |
| Where surface appearance of concrete is of importance | 0.5   |
| All other concrete                                    | 1.0   |

\* In case of manufactured sand, when material finer than 75-μm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

- 2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

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| Sieve Designation (Square Openings) | Percentage by Weight |
|-------------------------------------|----------------------|
| Retained on 1 3/4" sieve            | 0                    |
| Retained on 1 1/2" sieve            | 0 to 5               |
| Retained on 3/4" sieve              | 30 to 65             |
| Retained on 3/8" sieve              | 70 to 90             |
| Retained on No. 4 sieve             | 95 to 100            |
| Loss by Decantation Test            | 1.0 maximum          |

\* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

| Sieve Designation (Square Openings) | Percentage by Weight |
|-------------------------------------|----------------------|
| Retained on 3/8" sieve              | 0                    |
| Retained on No. 4 sieve             | 0 to 5               |
| Retained on No. 8 sieve             | 0 to 20              |
| Retained on No. 16 sieve            | 15 to 50             |
| Retained on No. 30 sieve            | 35 to 75             |
| Retained on No. 50 sieve            | 65 to 90             |
| Retained on No. 100 sieve           | 90 to 100            |
| Retained on No. 200 sieve           | 97 to 100            |

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.
- E. Mineral Filler: Type "C" or Type "F" fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Project Manager.

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## H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be re-bent.
3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

## .02 EQUIPMENT

- A. Conform Equipment to requirements of ASTM C 94.

## .03 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.
- B. Mix design to produce concrete which will have flexural strength of 500 psi at 7 days and 600 psi at 28 days. Slump of concrete shall be at least 2 inches but no more than 5 inches, when tested in accordance with ASTM C 143.
  1. Concrete pavement, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
  2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
  3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.
  4. Use retardant when temperature exceeds 90 degrees F. Proportion as

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recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

- C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:
  - 1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
  - 2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.
  - 3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5 inches, when tested in accordance with ASTM C 143.
  - 4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Section 02751 - Concrete Paving.

**PART 3 EXECUTION****.01 EXAMINATION**

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

**.02 PREPARATION**

- A. Properly prepare, shape and compact each section of sub grade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use sub grade planer to shape sub grade to its final cross section. Check contour of sub grade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

**.03 EQUIPMENT**

- A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
- B. Subgrade Planer and Template:
  - 1. Use subgrade planer with adjustable cutting blades to trim sub grade to exact section shown on Drawings. Select planer mounted on visible rollers, which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate sub grade



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- planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of sub base.
2. Provide template for checking contour of sub grade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.
- C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.
- D. Hand Finishing:
1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
  2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
- E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.
- F. Vibrators: Furnish mechanically operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.
1. Equip traveling paver with longitudinal trans angular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
  2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

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3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

**.04 FORMS**

- A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form is equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by AW Project Manager. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.
- B. Form Setting:
  1. Rest forms directly on sub-grade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Project Manager.
  2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

**.05 REINFORCING STEEL AND JOINT ASSEMBLIES**

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices.

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- Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to centerline of pavement, as shown.
  - C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.
  - D. Secure in required position to prevent displacement during placing and finishing of concrete.
  - E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
  - F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement requirements by more than 1 1/2 inches of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

**.06 FIBROUS REINFORCING**

- A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

**.07 PLACEMENT**

- A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.
- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.
- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little re-handling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

**.08 COMPACTION**

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- A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

**.09 FINISHING**

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
  - 1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.
- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.
- C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

**.010 JOINTS AND JOINT SEALING**

- A. Conform to requirements of Section 02752 - Concrete Pavement Joints.

**.011 CONCRETE CURING**

- A. Conform to requirements of Section 02753 - Concrete Pavement Curing.

**.012 TOLERANCES**

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high

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spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1 1/6 inch per foot from nearest point of contact. Maximum ordinate with 10- foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

**.013 FIELD QUALITY CONTROL**

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, the AW Project Manager may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 7 days or at number of hours as directed by the AW Project Manager for high early strength concrete. Test remaining two specimens at 28 days. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
- C. When compressive test indicates failure, make yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.
- E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to AW. In-place depth at these locations shall be average depth of four cores.
- F. Fill cores and density test sections with new concrete paving or non shrink grout.

**.014 NONCONFORMING PAVEMENT**

- A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings.

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- B. When measurement of any core is less than specified thickness by more than 10 percent, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to AW.

**.015 UNIT PRICE ADJUSTMENT**

- A. Unit price adjustments shall be made for in-place depth determined by cores as follows:
1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
  2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.
  3. Average depth below 90 percent but greater than 80 percent may be accepted by Project Manager at adjusted Unit Price of:
    - a.  $\text{Unit Price Bid} - [2 \times (1 - \text{ratio}) \times \text{Unit Price Bid}]$
    - b. Ratio equals average core thickness divided by thickness bid upon
    - c. 0.9 ratio pays 80 percent of unit price and 0.8 ratio pays 60 percent of unit price.
  4. Average depth below 80 percent will be rejected by AW Project Manager.

**.016 PAVEMENT MARKINGS**

- A. Restore pavement markings to match those existing in accordance with AW standard specifications and details and AW Project Manager's requirements.

**.017 PROTECTION**

- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.
- B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by AW Project Manager.
- C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by

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traffic. Opening of pavement to traffic shall not relieve responsibility for Work.

D. Maintain concrete paving in good condition until completion of Work.

E. Repair defects by replacing concrete to full depth.

**END OF SECTION**

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**SECTION 02752****CONCRETE PAVEMENT JOINTS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for street pavement expansion joints, with or without load transfer, is on linear foot basis.
  - 2. Payment for horizontal dowels is on a unit price basis for each horizontal dowel.
  - 3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
  - 4. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.
  - 5. Payment will be made for Preformed Expansion Joints on a linear foot basis only when field conditions require that sidewalk be moved adjacent to existing concrete structure (i.e., street, back of curb, etc.).
  - 6. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for



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**Concrete and Asphalt Pavements.****.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

**PART 2 PRODUCTS****.01 BOARD EXPANSION JOINT MATERIAL**

- A. Filler board of selected stock. Use wood of density and type as follows:
  - 1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
  - 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

**.02 PREFORMED EXPANSION JOINT MATERIAL**

- A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

**.03 JOINT SEALING COMPOUND**

- A. Conform joint sealants to one of sealant classes described in this section.
- B. Conform hot-poured rubber-asphalt compound to ASTM D 3405.
- C. Two-component Synthetic Polymer.
  - 1. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.
  - 2. Cure sufficiently at average temperature of  $25 \pm 1$  degree C ( $77 \pm 2$  degrees F) so as not to pick up under wheels of traffic in maximum three hours.
  - 3. Performance requirements shall meet above curing times and the requirements as follows:

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| <b>Cold-Extruded and Cold-Pourable (Self-Leveling) Specifications</b>   |                    |
|---|--------------------|
| <b>Property</b>   | <b>Requirement</b> |
| Penetration, 25 C (77 F) 150 g Cone, 5 s, 0.1 mm (in.), maximum   | 130                |
| Bond and Extension 50%, -29 C (-20 F), 3 cycles:<br><ul style="list-style-type: none"> <li>• Dry Concrete Block</li> <li>• Steel blocks (Primed, if recommended by manufacturer)</li> </ul> *Steel blocks shall be used when armor joints are specified | Pass<br>Pass       |
| Flow at 70 C (158 F)  | None               |
| Water content % by mass, maximum  | 5.0                |
| Resilience:<br><ul style="list-style-type: none"> <li>• Original sample, % min. (cured)</li> <li>• Oven-aged at 70 C (158 F), % min.</li> </ul>   | 50<br>50           |
| Cold-extruded material only - Cold Flow (10 minutes)  | None               |

After bond and extension test, there shall be no evidence of cracking, separation or other opening that is over 3 millimeters (1/8 inch) deep in sealer or between sealer and test blocks.

4. Provide cold-extruded type for vertical or sloping joints.
  5. Provide self-leveling type for horizontal joints.
- D. Self-Leveling, Low Modulus Silicone or Polyurethane Sealant for Asphaltic Concrete and Portland Cement Concrete Joints. This shall be a single component self-leveling silicone or polyurethane material that is compatible with both asphalt and concrete pavements. The sealer shall not require a primer for bond; a backer rod shall be required which is compatible with the sealant; no reaction shall occur between rod and sealant.
- E. When tested, self-leveling sealant shall meet following requirements:

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| Self Leveling, Low Modulus Silicone or Polyurethane Sealant  |   |
|--|---|
| Property   | Requirements  |
| Tack Free Time, 25 ± 1 C (77 ± 2 F), minutes   | 120 maximum   |
| Nonvolatile content, % by mass   | 93 minimum  |
| Tensile Strength and 24 Hour Extension Test:<br>• Initial, 10-day cure, 25 ± 1 C (77 ± 2 F), kPa (psi)<br>• After Water Immersion, kPa (psi)<br>• After Heat Aging, kPa (psi)<br>• After Cycling, -29 C (-20 F), 50%, 3 cycles, kPa (psi)<br>• 24 Hour Extension | <ul style="list-style-type: none"> <li>• 21 to 69 (3 to 10)</li> <li>• 21 to 69 (3 to 10)</li> <li>• 21 to 69 (3 to 10)</li> <li>• 21 to 69 (3 to 10)</li> <li>• Pass (All Specimens)</li> </ul> After 24 hours, there shall be no evidence of cracking, separation or other opening that is over 3 mm (1/8 in.) deep at any point in the sealer or between the sealer and test blocks. |

.04 LOAD TRANSMISSION DEVICES

- A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1 1/6 inch greater than diameter of dowel bar.
- B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

.05 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

- A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by AW Project Manager.

**PART 3 EXECUTION**

.01 PLACEMENT

- A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

.02 CONSTRUCTION JOINTS

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- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

**.03 EXPANSION JOINTS**

- A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

**.04 CONTRACTION JOINTS**

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

**.05 LONGITUDINAL WEAKENED PLANE JOINTS**

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

**.06 SAWED JOINTS**

- A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

**.07 JOINTS FOR CURB, CURB AND GUTTER**

- A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius

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returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

**.08 JOINTS FOR CONCRETE SIDEWALKS**

- A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend expansion joint material full depth of slab.

**.09 JOINTS FOR CONCRETE DRIVEWAYS**

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

**.010 JOINT SEALING**

- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.
- B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by AW Project Manager. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

**.011 PROTECTION**

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

**END OF SECTION**

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**SECTION 02753****CONCRETE PAVEMENT CURING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Curing of Portland cement concrete paving.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving, Concrete Sidewalks, Concrete Driveways, Curbs, and Curb and Gutters.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

**PART 2 PRODUCTS****.01 COVER MATERIALS FOR CURING**

- A. Conform curing materials to one of the following:
  - 1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
  - 2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.

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3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

**.02 LIQUID MEMBRANE-FORMING COMPOUNDS**

- A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m<sup>2</sup> in 72 hours using test method ASTM C 156.

**PART 3 EXECUTION****.03 CURING REQUIREMENT**

- A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.
- B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

**.01 POLYETHYLENE FILM CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
- B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

**.02 WATERPROOFED PAPER CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
- B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

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**.03 COTTON MAT CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.
- B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

**.04 LIQUID MEMBRANE-FORMING COMPOUNDS**

- A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.
- B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.
- C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by AW Project Manager, but not less than one gallon per 200 square feet of surface area.

**.05 TESTING MEMBRANE**

- A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.
- B. Reapply membrane compound immediately at no cost to AW when membrane fails above test.

**END OF SECTION**



**AW – US MILITARY  
STANDARD SPECIFICATION****CONCRETE DRIVEWAYS**

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**SECTION 02754****CONCRETE DRIVEWAYS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Portland cement concrete driveways.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for concrete driveways is on square foot basis, including excavation.
  - 2. No payment will be made for work in areas where driveway has been removed or replaced for Contractor's convenience.
  - 3. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving.
- B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 02751 - Concrete Paving.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 02752 - Concrete Pavement Joints.
- E. Sub grade Materials: Conform to sub grade material requirements.

**PART 3 EXECUTION****.01 PREPARATION**

- A. Prepare sub grade in accordance with contract document requirements.

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CONCRETE DRIVEWAYS

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.02 PLACEMENT

- A. Place and finish concrete in accordance with applicable portions of Section 02751 - Concrete Paving.

.03 JOINTS

- A. Install joints in concrete driveway in accordance with Section 02752 - Concrete Pavement Joints.

.04 CONCRETE CURING

- A. Cure concrete driveway in accordance with Section 02753 - Concrete Pavement Curing.

.05 PROTECTION

- A. Conform to applicable requirements of Section 02753 - Concrete Pavement Curing.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****CURB, CURB AND GUTTER AND HEADERS**

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**SECTION 02771****CURB, CURB AND GUTTER, AND HEADERS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.
- B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for curbs, curbs and gutter, and esplanade curbs is on linear foot basis measured along face of curb.
  - 2. Payment for 3 foot concrete valley gutter is on a linear foot basis.
  - 3. Payment for mountable concrete curbs is on a square foot basis.
  - 4. Payment for concrete paving headers and concrete railroad headers is on a linear foot basis.
  - 5. Payment for headers is on linear foot basis measured between lips of gutters adjacent to concrete base and measured between backs of curbs adjacent to concrete pavement.
  - 6. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit details of proposed formwork for approval.

**PART 2 PRODUCTS****.01 MATERIALS**

- C. Concrete: Conform to material and proportion requirements for concrete of

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STANDARD SPECIFICATION****CURB, CURB AND GUTTER AND HEADERS**

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**Section 02751 - Concrete Paving.**

- A. Reinforcing Steel: Conform to material requirements for welded wire fabric of Section 02751 - Concrete Paving.
- B. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.
  - 1. Compressive strength
    - a. At 7 days: 3500 psi
    - b. At 28 days: 8000 psi
  - 2. Initial set time: 45 minutes
  - 3. Final set time: 1.5 hours
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Section 02752 - Concrete Pavement Joints.
- E. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by AW Project Manager.

**PART 3 EXECUTION****.01 PREPARATION**

- A. Prepare sub grade in accordance with applicable portions of sections on excavation and fill, embankment, and sub grade and roadbed.

**.02 PLACEMENT**

- A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.
- B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.
- C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.
- D. Joints: Place in accordance with Section 02752 - Concrete Pavement Joints. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.
- E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

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STANDARD SPECIFICATION****CURB, CURB AND GUTTER AND HEADERS**

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**.03 MANUAL FINISHING**

- A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.
- B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.
- C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.
- D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.
- E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.
- F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

**.04 MECHANICAL FINISHING**

- A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by Project Manager. Use of mechanical methods shall provide specified curb design and finish.

**.05 CURING**

- A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Section 02753 - Concrete Pavement Curing.

**.06 TOLERANCES**

- A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straightedge laid along them, except at grade changes.

**.07 PROTECTION**

- A. Maintain curbs and gutters in good condition until completion of Work.
- B. Replace damaged curbs and gutters to comply with this Section.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****CONCRETE MEDIANS AND  
DIRECTIONAL ISLANDS**

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**SECTION 02772****CONCRETE MEDIANS AND DIRECTIONAL ISLANDS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Portland cement concrete medians and directional islands.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for concrete medians and directional islands is on square yard basis measured from back of curbs.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Section 02751 - Concrete Paving.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Section 02752 - Concrete Pavement Joints.
- E. Sub grade Materials: Conform to sub grade material to Contract Document requirements.

**PART 3 EXECUTION****.01 SUBGRADE**

- A. Prepare sub grade in accordance with Contract Document requirements.

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STANDARD SPECIFICATION

CONCRETE MEDIANS AND  
DIRECTIONAL ISLANDS

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.02 PLACEMENT OF CONCRETE

- A. Place and finish concrete in accordance with applicable portions of Section 02751 - Concrete Paving.

.03 JOINTS

- A. Install joints in accordance with Section 02752 - Concrete Pavement Joints.

.04 CONCRETE CURING

- A. Cure concrete in accordance with Section 02753 - Concrete Pavement Curing.

.05 PROTECTION

- A. Maintain concrete medians and directional islands in good condition until completion of work.
- B. Replace damaged concrete medians and directional islands to comply with this Section.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****CONCRETE SIDEWALKS**

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**SECTION 02775****CONCRETE SIDEWALKS****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Reinforced concrete sidewalks.
- B. Wheelchair ramps.
- C. Reinforced slope paving.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for concrete sidewalks is on square foot basis.
  - 2. No payment will be made for work outside these limits or in areas where driveway has been removed or replaced for Contractor's convenience.
  - 3. Payment for wheelchair ramps of each type specified is on square foot basis. Removal and replacement of existing sidewalk, curb or curb and gutter and saw-cutting is paid by unit cost for each item. Sodding will be paid one foot on each side of sidewalk unless otherwise noted. Staining of wheelchair ramps is included in cost of ramp.
  - 4. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
- B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- G. ASTM D 698 - Standard Test Methods for Laboratory Compaction



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STANDARD SPECIFICATION****CONCRETE SIDEWALKS**

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Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certified testing results and certificates of compliance.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving.
- B. Reinforcing Steel: Conform to material requirements of Section 02751 - Concrete Paving for reinforcing steel. Use No. 3 reinforcing bars.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 02752 - Concrete Pavement Joints.
- E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.
- F. Sand Bed: Conform to material requirements for bank run sand of Section 02320 - Utility Backfill Materials.
- G. Sodding: Conform to material requirements for sodding of Section 02922 – Sodding..
- H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Section 02761 - Colored Concrete for Medians and Sidewalks. Color shall be Brick Red or as shown on the drawings.

**PART 3 EXECUTION****.01 REPLACEMENT**

- A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.
- B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

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CONCRETE SIDEWALKS

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.02 PREPARATION

- A. Identify and protect utilities which are to remain.
- B. Protect living trees, other plant growth, and features designated to remain.
- C. Conduct clearing and grubbing operations in accordance with Section. 02233 - Clearing and Grubbing.
- D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.
- E. Immediately after subgrade is prepared, cover with compacted sand bed to depth as shown on
- F. Drawings. Lay concrete when sand is moist but not saturated.

.03 PLACEMENT

- A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 x 4's boards as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.
- B. Reinforcement:
  - 1. Install reinforcing bars.
  - 2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
  - 3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
  - 4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
  - 5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1 1/2 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.
- C. Expansion Joints: Install expansion joints with load transfer units in accordance with Section 02752 - Concrete Pavement Joints.
- D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.
- E. Strike off to smooth finish with wood strike board. Finish smoothly with wood

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CONCRETE SIDEWALKS

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hand float. Brush across sidewalk lightly with fine-haired brush.

- F. Apply coating to wheelchair ramp with contrasting color to match existing condition.
- G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.
- H. Finish edges with tool having 1/4 inch radius.
- I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material off site. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Section 02951 - Pavement Repair and Resurfacing.

.04 CURING

- A. Conform to requirements of Section 02753 - Concrete Pavement Curing.

.05 FIELD QUALITY CONTROL

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, the AW Project Manager may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.
- C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. If the Contractor places concrete without notifying the laboratory, AW will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.
- E. Sampling of fresh concrete shall be in accordance with ASTM C 172.
- F. Take slump tests when cylinders are made and when concrete slump appears excessive.
- G. Concrete shall be acceptable when average of two 28 day compression tests is

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STANDARD SPECIFICATION****CONCRETE SIDEWALKS**

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equal to or greater than minimum 28 day strength specified.

- H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.
- I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by AW Project Manager. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

**.06 NONCONFORMING CONCRETE**

- A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. Replace nonconforming sections at no additional cost to AW.

**.07 PROTECTION**

- A. Maintain newly placed concrete in good condition until completion of Work.
- B. Replace damaged areas.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****TOPSOIL**

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**SECTION 02911****TOPSOIL****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for topsoil under this Section. Include payment in Section 02921 - Hydro-mulch Seeding or Section 02922 - Sodding.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**PART 2****PRODUCTS****.01 TOPSOIL**

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:
  - 1. pH value of between 5.5 and 6.5
  - 2. Liquid limit: 50 or less
  - 3. Plasticity index: 20 or less
  - 4. Gradation: maximum of 10 percent passing No. 200 sieve
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

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STANDARD SPECIFICATION****TOPSOIL**

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**PART 3 EXECUTION****.01 EXAMINATION**

- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Project Manager.
- B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

**.02 TOPSOIL EXCAVATION**

- A. Conform to excavation and stockpiling requirements of Section 02315 - Roadway Excavation.

**.03 PLACEMENT**

- A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 02320 - Utility Backfill Material.
- C. For areas to receive shrubs or frees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.
- D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Waste Material Disposal.
- E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

**.04 PROTECTION**

- A. Protect topsoil from wind and water erosion until planting is completed.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****TREE PLANTING**

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**SECTION 02915****TREE PLANTING****PART 1. GENERAL****.01 SECTION INCLUDES**

- A. Street right-of-way tree planting and maintenance.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.

1. Payment for tree planting is on unit price basis for each tree planted.
2. When shown on Drawings or directed by AW Project Manager to remove and relocate tree affected by trench zone, work shall be paid for under one of the following bid items.
  - a. Bid item "Remove and Relocate Tree" includes moving tree with truck mounted tree spade and replanting same tree in new location. Payment is for each tree removed and relocated.
  - b. Bid item "Remove, Temporary Store and Replant Tree" includes moving tree with truck mounted tree spade and replanting tree at temporary location, (determined by Contractor) maintaining tree until construction is complete and replanting same tree back to its original location. Payment is for each tree removed, stored and replanted.
3. Refer to Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ANSI Z 60.1 Nursery Stock.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certification from supplier that each type of tree conforms to these specification requirements.
- C. For unpackaged materials, submit analysis by recognized laboratory made in accordance with methods established by Association of Official Agriculture Chemists, when applicable.
- D. Submit name and experience of qualified Arborist to AW Project Manager.

**AW – US MILITARY  
STANDARD SPECIFICATION****TREE PLANTING**

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- E. Submit temporary tree storage location. Location must be outside public right-of-way and within 5 miles of project site, unless otherwise approved by AW Project Manager.

**.05 QUALITY ASSURANCE**

- A. Landscaper shall be a firm specializing in landscape and planting work.
- B. Do not make substitutions of approved trees unless approved in writing by AW Project Manager. When specified planting material is not obtainable, submit proof of non-availability together with proposal for use of equivalent material. Substitutions of larger size or better grade than specified will be allowed, but with no increase in unit price.

**.06 DELIVERY, STORAGE, AND HANDLING**

- A. Ship trees with Certificates of Inspection as required by governing authorities. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name. Do not remove container grown stock from containers before time of planting.
- B. Deliver packaged materials in fully labeled original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at Site.
- C. Materials shall not be pruned prior to installation unless approved by Project Manager in writing. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Use protective covering during delivery.

**.07 WARRANTY**

- A. Warrant trees against defects including death, unsatisfactory growth, or loss of shape due to improper pruning, maintenance, or weather conditions, for 1 year after completion of planting. Plumb leaning trees during warranty period.
- B. Remove and replace trees found to be dead during warranty period. Remove and replace trees which are in doubtful condition at end of warranty period, or when approved by Project Manager, extend warranty period for trees for full growing season.

**PART 2 PRODUCTS****.01 TREES**

- A. Provide container grown trees which are straight and symmetrical and have persistently preferred main leader. Crown shall be in good overall proportion to entire height of tree with branching configuration as recommended by ANSI Z60.1 for type and species specified. Where clump is specified, furnish plant having minimum of three stems originating from common base at ground line.



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STANDARD SPECIFICATION****TREE PLANTING**

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Measure trees by average caliper of trunk as follows:

1. For trunks up to 4 inches or less in diameter, measure caliper 6 inches above top of root ball.
  2. For trunks more than 4 inches, measure caliper 12 inches above top of root ball.
  3. Caliper measurements shall be by diameter tape measure. Indicated calipers on plans are minimum. Averaging of plant calipers will not be allowed.
- B. Trees shall conform to following requirements:
1. Healthy, vigorous stock, grown in recognized nursery.
  2. Free of disease, insects, eggs, larvae; and free of defects such as knots, sun-scald, injuries, abrasions, disfigurement, or borers and infestations.

**.02 SOIL PRODUCTS**

- A. Topsoil: Conform to requirements of Section 02911 - Topsoil.
- B. Peat moss, bark, and fertilizer: Use material recommended by nursery for establishment of healthy stock after replanting.

**.03 STAKES AND GUYS**

- A. Provide minimum 8-foot long steel T-stakes and 1 inch wide plastic tree chains.
- B. Where applicable for anchoring trees, use wood deadmen of at least 2 by 4 stock, 36 inches long and buried 3 feet. Provide white surveyor's plastic tape for flagging tree guys.

**.04 TREE WRAP, TWINE, AND SEAL**

- A. Wrap: First quality, bituminous impregnated tape, corrugated or crepe paper, specifically manufactured for tree wrapping and having qualities to resist insect infestation.
- B. Twine: Lightly tarred, medium-coarse sisal (lath) yarn. Do not use nails or staples to fasten wrapping.
- C. Seal: Commercially available asphaltic-base black emulsion specifically produced for use in sealing tree cuts and wounds.

**.05 WATER**

- A. Water shall be potable from municipal water supplies.

**.06 SOURCE QUALITY CONTROL**

- A. Notify AW Project Manager, prior to installation, of location where trees that have been selected for planting may be inspected. Plant material will be inspected for compliance with following requirements.

**AW – US MILITARY  
STANDARD SPECIFICATION****TREE PLANTING**

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1. Genus, species, variety, size and quality.
2. Size and condition of balls and root systems, insects, injuries and latent defects.

**PART 3 EXECUTION****.01 PREPARATION**

- A. Schedule work so that planting can proceed rapidly as portions of site become available. Plant trees after final grades are established and prior to planting of lawns, unless otherwise approved by Project Manager in writing. When planting of trees occurs after seeding work, protect lawn areas and promptly repair damage to lawns resulting from tree planting operations.
- B. Layout individual trees at locations shown on Drawings. In case of conflicts, notify Project Manager before proceeding with Work. Trees shall be staked and approved by Project Manager prior to planting.

**.02 PREPARATION OF PLANTING SOIL**

- A. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Strip and utilize 4 inch layer of top soil, placed on esplanades under Section 02921 - Hydro-mulch Seeding, for planting soil mixture.
- C. Mix recommended soil amendments with topsoil at following rates:
  1. Top soil: 50 percent.
  2. Peat moss: 25 percent.
  3. Well rotted Bark: 25 percent.
  4. Fertilizer: Rate recommended by nursery.
- D. Delay mixing of fertilizer when planting will not follow placing of planting soil within 48 hours, unless otherwise directed.
- E. Incorporate amendments into soil as part of soil preparation process prior to fine grading, fertilizing, and planting. Broadcast or spread amendments evenly at specified rate over planting area. Thoroughly incorporate amendments into top 3 or 4 inches of soil until amendments are pulverized and have become homogeneous layer of topsoil ready for planting.

**.03 PLANTING**

- A. Excavate pits, beds, or trenches with vertical sides and with bottom of excavation raised minimum of 6 inches at center for proper drainage. Provide following minimum widths:
  1. 15 gallon containers or larger, 2 feet wider than diameter of root ball.
  2. 1 and 5 gallon containers, 6 inches wider than diameter of root ball.

**AW – US MILITARY  
STANDARD SPECIFICATION****TREE PLANTING**

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- B. When conditions detrimental to plant growth are encountered, such as unsatisfactory soil, obstructions, or adverse drainage conditions, notify AW Project Manager before planting.
- C. Deliver trees after preparations for planting have been completed and plant immediately. When planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture, and water as needed.
- D. Set root ball on undisturbed soil in center of pit or trench and plumb plant. Place plants at level that, after settlement, natural relationship of plant crown with ground surface will be established.
- E. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
- F. Dish top of backfill to allow for mulching. Mulch pits, trenches and planted areas. Provide not less than 4 inch thickness of mulch, work into top of backfill, and finish level with adjacent finish grades. Cover entire root ball.
- G. Prune, thin out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed in writing, do not cut tree leaders, and remove only injured and dead branches from flowering trees. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- H. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures.
- I. Guy and stake trees immediately after planting.
- J. Control dust caused by planting operations. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.

**.04 FIELD QUALITY CONTROL**

- A. Project Manager may reject unsatisfactory or defective material at anytime during progress of Work. Remove rejected trees immediately from site and replace with specified materials. Plant material not installed in accordance with these Specifications will be rejected.
- B. An inspection to determine final acceptance will be conducted by AW Project Manager at end of 12 month maintenance period. Additional inspections will be conducted for extended warranty periods provided for in paragraph 1.07B.

**.05 MOVING EXISTING TREES**

- A. Perform tree moving and replanting by a professional Arborist during dormant growth season.

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TREE PLANTING

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- B. Provide tree spade of adequate size as directed by professional Arborist.

.06 MAINTENANCE

- A. Maintain trees during planting operations and for period of 12 months after completion of planting.
- B. Water trees to full depth minimum of once each week, or as required to maintain healthy vigorous growth.
- C. Prune, cultivate, and weed as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports, and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

.07 CLEANUP AND PROTECTION

- A. During planting work, keep pavements clean and work *area* in orderly condition.
- B. Protect planting work and materials from damage due to planting operations. Maintain protection during installation and maintenance period. Treat, repair, or replace damaged planting work as directed by AW Project Manager.
- C. Dispose of excess soil and waste off site. On-site burning of combustible cleared materials will not be permitted.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****HYDRO MULCH SEEDING**

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**SECTION 02921****HYDRO MULCH SEEDING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for hydro mulch seeding is on an acre basis.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of applicable State Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these specifications and requirements of applicable State Fertilizer Law.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Topsoil: Conform to material requirements of Section 02911 - Topsoil.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and applicable State Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:
  - 1. Rye: Fresh, clean, Italian rye grass seed (*lollium multi-florum*), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
  - 2. Bermuda: Extra-fancy, treated, lawn type common bermuda (*Cynodon dactylon*). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.

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**HYDRO MULCH SEEDING**

3. Wet, moldy, or otherwise damaged seed will not be accepted.
4. Seed requirements, application rates, and planting dates are:

| <b>TYPE</b>                         | <b>APPLICATION<br/>RATE POUNDS/A</b> | <b>PLANTING DATE</b> |
|-------------------------------------|--------------------------------------|----------------------|
| Hulled Common Bermuda Grass 98/88   | 40                                   | Jan 1 to Mar 31      |
| Unhulled Common Bermuda Grass 98/88 | 40                                   |                      |
| Hulled Common Bermuda Grass 98/88   | 40                                   | Apr 1 to Sep 30      |
| Hulled Common Bermuda Grass 98/88   | 40                                   | Oct 1 to Dec 31      |
| Unhulled Common Bermuda Grass 98/88 | 40                                   |                      |
| Annual Rye Grass (Gulf)             | 30                                   |                      |

- C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of following elements:
  1. Nitrogen: 10 Percent
  2. Phosphoric Acid: 20 Percent
  3. Potash: 10 Percent
- D. Mulch:
  1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
  2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
  3. Dye mulch green for coverage verification purposes. 02921-2
- E. Soil Stabilizer: "Terra Tack 1" or approved equal.
- F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

**PART 3 EXECUTION**

**.01 PREPARATION**

- A. Place and compact topsoil in accordance with requirements of Section 02911 - Topsoil.
- B. Dispose of Objectionable and Waste Materials off site as per Contract Document requirements.

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HYDRO MULCH SEEDING

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.02 APPLICATION

- A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.
- B. Fertilizer: Apply uniformly at rate of 500 pounds per acre.
- C. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.
- D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.
- F. Sod: Lay single row of sod along perimeter where topsoil and pavement intersect. Apply in conformance to Section 02922 - Sodding.
- G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain AW Project Manager approval before resuming operations.

.03 MAINTENANCE

- A. Maintain grassed areas minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.
- C. Repair areas damaged by erosion by regrading, rolling and replanting.
- D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.
- E. Mow grass when height reaches 3 1/2 inches or greater on average before final acceptance. Mow to height of 2 1/2 inches.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****SODDING**

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**SECTION 02922****SODDING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.
- B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.
- C. Sod is defined as blocks, squares, strips of turf grass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.
- D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for sodding is on square yard basis.
  - 2. Refer to Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.

**.04 QUALITY ASSURANCE**

- A. Sod only when weather and soil conditions are deemed by AW Project Manager to be suitable for proper placement.
- B. Water and fertilize new sod.
- C. Guarantee sod to be growing 30 days after date of substantial completion.
- D. Maintenance Period:
  - 1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.
  - 2. Resod unacceptable areas.
  - 3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good



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horticultural practice to ensure normal, vigorous and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State where the project is being completed.

- E. Notify AW Project Manager 10 days before end of maintenance period for inspection.

**PART 2 PRODUCTS****.01 SOD**

- A. Species: Bermuda (*Cynodon Dactylon*), Buffalo (*Buchloe Dactyloides*), or St. Augustine (*Stenotaphrum Secundatum*) Gulf Coast variety to match existing sod.
- B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.
- C. Size: 12 inch wide strips, uniformly 2 inches thick with clean-cut edges.
- D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

**.02 FERTILIZER**

- A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

**.03 WEED AND INSECT TREATMENT**

- A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to AW Project Manager for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State where the project is being completed.

**.04 WATER**

- A. Potable, available on-site through Contractor's water trucks. Contractor may use AW water system hydrants when water use is measured through Contractor's meter. Do not use private resident's water.

**.05 BANK SAND**

- A. Free of clay lumps, roots, grass, salt or other foreign material.

**PART 3 EXECUTION**

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.01 PREPARATION

- A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.
- B. Top soil shall be free of weeds and foreign material immediately before sodding.
- C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.
- D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.
- E. Spread 2 inch layer of bank sand over areas to be sodded prior to planting of sod.
- F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

.02 APPLICATION

- A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.
- B. On slopes 2:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.
- D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.
- E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to AW Project Manager for approval, prior to construction.

.03 MAINTENANCE

- A. Watering:
  - 1. Water lawn areas once a day with minimum 1/2 inch water for first 3 weeks after area is sodded.
  - 2. After 3 week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.
  - 3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.
  - 4. Water in afternoon or at night to enable soil to absorb maximum amount of water

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with minimum evaporation.

**B. Mowing:**

1. Mow sod at intervals which will keep grass height from exceeding 3 1/2 inches.
2. Set mower blades at 2 1/2 inches.
3. Do not remove more than one-half of grass leaf surface.
4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.
5. Remove grass clippings during or immediately after mowing.

**C. Fertilizer and Pest Control:**

1. Evenly spread fertilizer composite at rate of 40 pounds per 5000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.
2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.
3. Apply mixture 1/4 to 1/2 inch thick.
4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

**D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.**

**.04 CLEANUP**

- A. During the course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.
- B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.
- C. Dispose of unused materials and rubbish of site as per Contract Document requirements.

**END OF SECTION**

**AW – US MILITARY  
STANDARD SPECIFICATION****PAVEMENT REPAIR AND RESURFACING**

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**SECTION 02951****PAVEMENT REPAIR AND RESURFACING****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Repairing and resurfacing streets, highways, driveways, sidewalks, and other pavements that have been cut, broken, or otherwise damaged during construction.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for pavement repair and resurfacing under this Section. Payment will be in accordance with Measurement and Payment for work as required in appropriate sections.
  - 2. Refer to Measurement and Payment for other unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this section is included in total Stipulated Price.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Subgrade:
  - 1. Provide backfill material as required by applicable excavation and fill sections Sections 02315 through 02319.
  - 2. Provide material for stabilization as required.
- B. Base: Provide base material as required by applicable portions of Section 02711 - Hot Mix Asphaltic Base Course, and Section 02712 - Cement Stabilized Base Course.
- C. Pavement: Provide paving materials as required by applicable portions of Section 02741 - Asphaltic Concrete Pavement, Section 02751- Concrete Paving, Section 02754 - Concrete Driveways, and Section 02771 - Curb, Curb and Gutter, and Headers, and Section 02775 - Concrete Sidewalks.

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**PART 3 EXECUTION****.01 PREPARATION**

- A. Notify AW prior to commencement of excavation in pavement for which an Excavation in Public Way permits has been obtained. Follow directions contained in the permit.
- B. Conform to requirement of Section 02221 - Removing Existing Pavements and Structures, for removals.
- C. Saw cut pavement 18 inches wider than width of trench needed to install utilities unless otherwise indicated on Drawings.
- D. When removing pavement to existing deformed metal strip (i.e. dummy joint), saw cut pavement minimum 2 inches deep on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.
- E. Protect edges of existing pavement to remain from damage during removals, utility placement, backfill, and paving operations. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.
- F. Dowel in existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by AW Project Manager, provide No. 6 bars 24 inches long, drilled and embedded 8 inches into center of existing slab with PO-ROC epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing.
- G. Provide transitional paving and earthwork as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

**.02 INSTALLATION**

- A. Parking Areas, Service Drives, Driveways, and Sidewalks: Replace with material equal to or better than existing or as indicated on Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01, Materials.
- B. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base, and surface course with like materials or as indicated on Drawings. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01, Materials.
- C. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on Drawings. Place types and spacing of joints to match existing or as indicated on Drawings.
- D. Where existing pavement consists of concrete pavement with asphaltic surfacing,

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resurface with minimum 2 inch depth asphaltic pavement.

- E. Repair state highway and county crossings in accordance with applicable permit or county requirements as appropriate and within 1 week after utility work is installed.

.03 WASTE MATERIAL DISPOSAL

- A. Dispose of waste materials off site, in accordance with requirements of the Contract Documents.

.04 PROTECTION

- A. Maintain pavement in good condition until completion of Work.
- B. Replace pavement damaged by Contractor's operations at no cost to AW.

**END OF SECTION**

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STANDARD SPECIFICATION****CONCRETE FOR UTILITY CONSTRUCTION**

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**SECTION 03315****CONCRETE FOR UTILITY CONSTRUCTION****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure.
  - 2. Obtain services of and pay for certified testing laboratory to prepare design mixes.
  - 3. Refer to Special Provisions section of Contract Document for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.
- H. ACI 315 - Details and Detailing of Concrete Reinforcement.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.
- J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber

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Reinforced Concrete.

- K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
- Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
- R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- S. ASTM C 33 - Standard Specification for Concrete Aggregates.
- T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- Y. ASTM C 150 - Standard Specification for Portland Cement.
- Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.  
03315-2
- AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.



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- AF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- FF. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- GG. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- HH. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
- II. CRSI MSP-1 - Manual of Standard Practice. AK. CRSI - Placing Reinforcing Bars.
- JJ. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
- KK. NRMCA - Concrete Plant Standards.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work.
- C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by AW Project Manager.
- E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.
- G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

**.05 HANDLING AND STORAGE**

- A. Cement: Store cement off of ground in well-ventilated, weatherproof building.
- B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.
- C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

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**PART 2 PRODUCTS****.01 CONCRETE MATERIALS****A. Cementitious Material:**

1. Portland Cement: ASTM C 150, Type H, unless use of Type III is authorized by AW Project Manager; or ASTM C 595, Type IP. For concrete in contact with sewage use Type H cement.
2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of  $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ .

**B. Water:** Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.**C. Aggregate:**

1. Coarse Aggregate: ASTM C 33. Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.
2. Fine Aggregate: ASTM C 33.
3. Determine potential reactivity of fine and coarse aggregate in accordance with Appendix to ASTM C 33.

**D. Air Entraining Admixtures:** ASTM C 260.**E. Chemical Admixtures:**

1. Water Reducers: ASTM C 494, Type A.
2. Water Reducing Retarders: ASTM 494, Type D.
3. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G.

**F. Prohibited Admixtures:** Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.**G. Reinforcing Steel:**

1. Use new billet steel bars conforming to ASTM A 615, ASTM A 767, or ASTM A 775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.
2. Where shown, use welded wire fabric with wire conforming to ASTM A 185 or ASTM A 884. Supply gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.
3. Wire: ASTM A 82. Use 16 1/2 gauge minimum for tie wire, unless otherwise

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indicated.

H. Fiber:

1. Fibrillated Polypropylene Fiber:

- a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.
- b. Physical Properties:
  1. Material: Polypropylene
  2. Length: 1/2 inch or graded
  3. Specific Gravity: 0.91
- c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.

- a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
- b. Physical Properties
  1. Material: Steel
  2. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
  3. Specific Gravity: 7.8
  4. Tensile Strength: 40-400 ksi.
  5. Young's Modulus: 29,000 ksi
  6. Minimum Average Tensile Strength: 50,000 psi
  7. Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking

I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

.02 FORM WORK MATERIALS

- A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.
- B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.

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- C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.
- E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

.03 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

.04 MEASUREMENT OF MATERIALS

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.
- B. Measure water and liquid admixtures by volume.

.05 DESIGN MIX

- A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to AW Project Manager for review.
- C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by AW Project Manager.

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D. Classification:

| CLASS | TYPE                             | MINIMUM<br>COMPRESSIVE<br>STRENGTH<br>(LBS/SQ. IN.) |        | MAXIMUM<br>W/C RATIO | AIR<br>CONTENT<br>(PERCENT) | CONSISTENCY<br>RANGE IN<br>SLUMP<br>(INCHES) |
|-------|----------------------------------|---|--------|----------------------|-----------------------------|--|
|       |                                  | 7-DAY   | 28-DAY |                      |                             |  |
| A     | Structural                       | 3200  | 4000   | 0.45                 | 4 +/- 1                     | 2 to 4*                                      |
| B     | Pipe Block Fill,<br>Thrust Block | ----  | 1500   |                      | 4 +/- 1                     | 5 to 7                                       |

\*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

.06 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops:
  - 1. Thickness: not less than 3/8 inch
  - 2. Acceptable Manufacturers:
    - a. Kirkhill Rubber Co., Brea, California
    - b. Water Seals, Inc., Chicago, Illinois
    - c. Progress Unlimited, Inc., New York, New York
    - d. Greenstreak Plastic Products Co., St. Louis, Missouri
    - e. Approved equal.

.07 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.
- B. Bentonite Waterstop:

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1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
  2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
  3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch
  4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
  2. Meets or exceeds requirements of Federal Specification SS-S-210A.
  3. Supplied wrapped completely by 2 part protective paper.
  4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
  5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
  6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

**PART 3 EXECUTION****.01 FORMS AND SHORING**

- A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.
- B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.
- C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.
- D. Back form work with sufficient number of studs and wales to prevent deflection.
- E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and

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wales. In such cases, form lining will not be required.

- F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).
- G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.
- H. Treat facing of forms with approved form coating before concrete is placed. When directed by AW Project Manager, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

## .02 PLACING REINFORCEMENT

- A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by Project Manager and obtain acceptance before concrete is placed.
- B. Minimum spacing center-to-center of parallel bars: 2 1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.
- C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.
- D. Do not splice bars without written approval of Project Manager. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

## .03 EMBEDDED ITEMS

- A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.
- B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

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.04 BATCHING, MIXING AND DELIVERY OF CONCRETE

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.
- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Project Manager before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.
- E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.
- F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- G. Hand-mix only when approved by AW Project Manager.

.05 PLACING CONCRETE

- A. Give sufficient advance notice to AW Project Manager (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to AW Project Manager's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting



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reinforcement or anchor bolts.

- E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.
- G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.
- H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

#### .06 WATERSTOPS

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.
- C. Splicing PVC Waterstops:
  - 1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
  - 2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.
  - 3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Project Manager, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.
- D. Setting PVC Waterstops:
  - 1. Correctly position waterstops during installation. Support and anchor waterstops

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during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.
- E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.
- F. Resilient Waterstop:
  1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
  2. When requested by AW Project Manager, provide technical assistance by manufacturer's representative in field at no additional cost to AW.
  3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
  4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
  5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.
  6. Bentonite Waterstop:
    - a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
    - b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
    - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
    - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory

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substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

- e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.

7. Adhesive Waterstop:

- a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
- b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
- c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
- d. Do not remove protective paper until just before final form work completion. Place concrete immediately. Time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

.07 CONSTRUCTION JOINTS

A. Definitions:

- 1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
- 2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Project Manager. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
- 3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

.08 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface

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after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Project Manager.

- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.
- C. Rubbed Finish:
  - 1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
  - 2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.
- D. Unformed Surfaces: Cure by membrane curing compound method.
  - 1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by AW Project Manager. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
  - 2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
  - 3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

#### .09 REMOVAL OF FORMS AND SHORING

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete

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placement.

- B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Project Manager.

#### .010 DEFECTIVE WORK

- A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

#### .011 FINISHING

- A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.
- B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.
- C. Apply wood float finish to concrete slabs.

#### .012 FIELD QUALITY CONTROL

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, AW may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. Unless otherwise directed by AW Project Manager, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements

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of ASTM C 1077.

1. Take concrete samples in accordance with ASTM C 172.
  2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
  3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
  4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C 42.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.
- E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by AW Project Manager, at no additional cost to AW.

**.013 PROTECTION**

- A. Protect concrete against damage until final acceptance by AW.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by AW Project Manager.

**END OF SECTION**

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**SECTION 04061****MORTAR****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Mortar and grout for masonry.

**.02 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for mortar under this Section. Include payment in Lump Sum for building or structure with price breakdown included in Schedule of Prices.
  - 2. Refer to Special Provisions section of Contract Document for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**.03 REFERENCES**

- A. ASTM C 143 - Standard Testing Method for Slump of Hydraulic Cement Concrete
- B. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
- C. ASTM C 150 - Standard Specification for Portland Cement.
- D. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- E. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.
- F. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout.
- G. ASTM C 476 - Standard Specification for Grout for Masonry.
- H. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- I. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Include design mix, indicate Property Method used, required environmental conditions, and admixture limitations.

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- C. Samples: Submit two ribbons of each mortar color, illustrating color and color range.
- D. Submit two copies of test reports.
- E. Submit test reports on mortar indicating conformance to ASTM C 270.
- F. Submit test reports on grout indicating conformance to ASTM C 476.
- G. Submit manufacturer's certificate, that products meet or exceed specified requirements.

**.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site, store and protect.
- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

**.06 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain materials and surrounding air temperatures to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

**.07 MIX TESTS**

- A. Test mortar and grout.
- B. Testing of Mortar Mix: Test in accordance with ASTM C 780. Test mortar mix for compressive strength, consistency, mortar aggregate ratio, water content, air content, and splitting tensile strength.
- C. Testing of Grout Mix: Test in accordance with ASTM C 109. Test grout mix for compressive strength and slump.

**PART 2 PRODUCTS****.01 MATERIALS**

- A. Portland Cement: ASTM C 150, Type I, white color.
- B. Masonry Cement: Not permitted.
- C. Mortar Aggregate: ASTM C 144, standard masonry type. Grading and color suitable for type of masonry, one source for entire project. (Not less than 5 percent shall pass No. 100 sieve).
- D. Hydrated Lime: ASTM C 207, Type S.
- E. Grout Aggregate: ASTM C 404.
- F. Water: Clean and potable.



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.02 MORTAR COLOR

- A. Mortar Color: Mineral oxide pigment; color; to be selected by AW Project Manager from manufacturer's samples.

.03 ADMIXTURES

- A. Antifreeze: Antifreeze admixtures will not be permitted.
- B. Accelerator: Accelerator may be used only with approval of AW Project Manager.

.04 MORTAR

- A. Mortar for Load Bearing Walls and Partitions: ASTM C 270, Type S utilizing Property Method to achieve 1800 psi strength.
- B. Mortar for Non-load Bearing Walls and Partitions: ASTM C 270, Type S utilizing the Property Method to achieve 1800 psi strength.
- C. Mortar for Masonry Below Grade or in Contact with Earth: ASTM C 270, Type M utilizing the Property Method to achieve 2500 psi strength.
- D. Pointing Mortar: ASTM C 270, Type N, using the Property Method to achieve 750 psi strength.

.05 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 270 to achieve strengths noted in Paragraph 2.04.
- B. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower freezing point of mortar.
- D. If water is lost by evaporation, retemper only within 2 hours of mixing.
- E. Use mortar within 2 hours after mixing at temperatures of 80 degrees F, or 2 1/2 hours at temperatures under 50 degrees F.

.06 GROUT

- A. Bond Beams, Lintels, and Other Areas to be Grouted Solid: 3000 psi strength at 28 days; 7 to 8 inches slump per ASTM C 143; mixed in accordance with ASTM C 476, Fine Grout.

.07 GROUT MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 476, Fine Grout.
- B. Add admixtures in accordance with manufacturer's instructions. Provide

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uniformity of mix.

- C. Do not use anti-freeze compounds to lower freezing point of grout.

**PART 3 EXECUTION****.01 EXAMINATION**

- A. Request inspection of spaces to be grouted.

**.02 PREPARATION**

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean out holes with masonry units to prevent leakage of grout materials.  
Brace masonry for wet grout pressure.

**.03 INSTALLATION**

- A. Install mortar and grout in accordance with manufacturer's instructions.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not displace reinforcement while placing grout.
- D. Remove grout spaces of excess mortar.

**END OF SECTION**

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UTILITY CONSTRUCTION**

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**SECTION 04210****BRICK MASONRY FOR UTILITY CONSTRUCTION****PART 1 GENERAL****.01 SECTION INCLUDES**

- A. Brick masonry work in utility construction for permanent or temporary installation of below ground structures.
- B. Brick masonry in repair and rehabilitation of utility lines and associated structures.

**.02 UNIT PRICES**

- A. No payment will be made for brick masonry under this Section unless specifically noted in bid documents. Include payment in unit price for applicable utility structure section.

**.03 REFERENCES**

- A. ASTM C 32 - Specification for Sewer and Manhole Brick (Made from Clay or Shale).
- B. ASTM C 55 - Standard Specification for Concrete Building Brick.
- C. ASTM C 62 - Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).
- D. ASTM C 67 - Methods of Sampling and Testing Brick and Structural Clay Tile.
- E. ASTM C 91 - Specification for Masonry Cement.
- F. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
- G. ASTM C 140 - Standard Method of Sampling and Testing Concrete Masonry Units.
- H. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.

**.04 SUBMITTALS**

- A. Conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certification from the manufacturer that brick units meet applicable requirements of reference standards.
- C. As an alternate to providing certification, submit test results that show brick units meet applicable requirements of reference standards, when tested by

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an approved independent testing laboratory. Test result submittals shall be at no cost to AW.

**.05 HANDLING AND STORAGE**

- A. Handle and store brick to prevent damage.
- B. Store brick and mortar mix off the ground and in a dry place. Cover mortar mix to protect from weather.

**PART 2 PRODUCTS****.01 CLAY AND SHALE BRICK MASONRY UNITS**

- A. Manholes and Structures: Use brick units made from clay or shale conforming to requirements of ASTM C 32, Grade MM, either cored or solid. Units shall have the following physical properties:
  - 1. Compressive Strength: 2200 psi minimum for individual brick; 2500 psi average for five bricks.
  - 2. Size: 2-1/4" by 7-5/8" by 3-5/8".
  - 3. Test Procedure: ASTM C 67.
- B. Sewer Brick: Use brick units made from clay or shale conforming to requirements of ASTM C 32, Grade SM, either cored or solid. Units shall have the following physical properties:
  - 1. Compressive Strength: 3750 psi minimum for individual brick; 5000 psi average for 5 bricks.
  - 2. Size: 2-1/4" by 7-5/8" by 3-5/8".
  - 3. Test Procedure: ASTM C 67.

**.02 CONCRETE BRICK MASONRY UNITS**

- A. Manholes and Structures: Conform to requirements of ASTM C 55, grade S-1.
- B. Dimensions: 2-1/4" by 7-5/8" by 3-5/8".

**.03 MORTAR**

- A. Provided mortar conforming to the requirements of Section 4061 - Mortar.

**PART 3 EXECUTION****.01 EXAMINATION**

- A. Ensure that foundations and other surfaces to support brickwork are at proper grades and elevations. Correct improperly prepared surfaces. Work surfaces and

**AW – US MILITARY  
STANDARD SPECIFICATION****BRICK MASONRY FOR  
UTILITY CONSTRUCTION**

---

masonry shall be free of dirt, grease, oil, or other harmful materials before starting brick masonry work.

**.02 WEATHER REQUIREMENTS**

- A. Lay no masonry when temperature of outside air is below 50 degrees F, unless satisfactory means are provided to heat materials and protect work from cold and frost.
- B. Maintain mortar at 50 degrees F or above and ensure that mortar will harden without freezing.

**.03 BRICK PLACEMENT**

- A. Use sewer brick where exposed to flow. Where not exposed to flow, use manhole brick.
- B. Lay sewer brick with the 2-1/4" by 7-5/8" side exposed to flow.
- C. Lay manhole bricks so that in every fifth course the long axis of bricks are perpendicular to the long axis of the four preceding courses.
- D. Lay curved courses, and courses in different planes, using bonded and keyed construction.
- E. Lay brick plumb and true with courses level and uniformly spaced. Adjust the bond of face brick so that no course will terminate with a piece less than one-half length of brick.
- F. Dampen brick prior to placement.
- G. Where fresh masonry joins partially set or totally set masonry, clean surfaces of set masonry. Remove loose mortar and brick. Wet brick to obtain the best possible bond.
- H. Immediately remove mortar droppings and splashing as work progresses to facilitate final cleaning.

**.04 JOINTS**

- A. Completely fill joints in brick and other materials with mortar as each course is laid.
- B. Make joints in exposed brickwork a uniform 3/8-inch wide, unless otherwise shown on Drawings.
- C. When mortar is "thumbprint" hard, tool exposed joints with a round or other suitable jointer that is slightly larger than width of the mortar joint. In tooling, make sure that cracks and crevices are closed.
- D. Point holes in exposed masonry. Cut out defective joints and repoint.

**AW – US MILITARY  
STANDARD SPECIFICATION****BRICK MASONRY FOR  
UTILITY CONSTRUCTION**

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**.05 FIELD QUALITY CONTROL**

- A. The Contractor will retain and will be required to conduct random performance testing to the requirements as outlined below, using an independent Testing Laboratory Services firm so qualified conduct the necessary testing. The designated Testing Laboratory Services firm to be approved by AW Project Manager. In addition, AW may elect to retain their own Testing Company to qualify/substantiate the findings/results of the Testing Firm retained by the Contractor.
- B. A minimum of one set of mortar samples shall be molded for each day's placement as directed by AW Project Manager. Mold three 2-inch cube specimens. One cube will be tested for compressive strength at 7 days and 2 cubes will be tested for compressive strength at 28 days in accordance with ASTM C 109.
- C. Each load of bricks delivered to the jobsite shall be tested.
  - 1. Test clay bricks in accordance with ASTM C 167.
  - 2. Test concrete bricks in accordance with ASTM C 140.

**END OF SECTION**

**Appendix BB**  
**Contractor Applied Pesticides**

**Requirements for information for contractor applied Pesticides**  
**Minimum of 3 days prior to proposed application**

1. Copy of current State License for company and applicator.
2. Copy of current company insurance verification for vehicle and Pesticide application coverage
3. Square footage of treatment area and linier feet of vertical (thickened slab GC must provide to subcontractor)
4. MSDS and label of Pesticide. The only Installation authorized pesticide for pre-treatment are:
  - TERMIDOR 80WG 80.00% (Fipronil)
  - TERMIDOR SC 9.10% (Fipronil)

Due to the effectiveness and low odor, AEC requires TERMIDOR 80WG or TERMIDOR SC be used.

5. Nomenclature of pump, and sprayer, (if possible- not required)
6. Mixing tank capacity
7. A written plan of application to include dilution calculations and application.
8. All chemical containers to be used will be unopened (seal and label intact) and inspected by Government Rep. or Installation Pest Management Coordinator
9. All empty containers shall be disposed of off-post.
10. All submittal requirements of the contract.
11. The Label is the Law. Label information shall be strictly followed!

**21 days prior to proposed application**

If a different chemical is requested for use, DPW pest management coordinator must have the MSDS and a copy of the label 3 weeks in advance of proposed treatment to see if chemical is legal in Oklahoma and attempt AEC approval.

**Day of Application and submittal was approved**

1. Demonstrate with water only, calibration of spray equipment and applicator
2. Government inspects unopened pesticide containers
3. Rain must not be expected the day of application (Label is the Law)
4. Contractor shall prepare a certification document to include Name of chemical, percent of active ingredient, pounds of active ingredients that were applied to the site, and total square footage / Linier footage (witch ever applies) that received pesticide. There shall be a signature line for the Applicator and the Government Representative.



**Appendix CC**  
**Oklahoma Natural Gas**



## NEW SERVICE LINE POLICY EXPLANATION

FORM 1931

**New rules approved by the Oklahoma Corporation Commission allow Oklahoma Natural Gas Company (ONG) to put the natural gas meter next to your house and to install the natural gas piping between the property line and your house. The following is a summary of your options and rights and responsibilities, as well as those of ONG.**

### **ONG will:**

1. Discuss your options with you and work out a mutually agreeable location for the meter near the outside wall of the first building to be served.
2. Install a service line, at ONG's cost up to a maximum allowable investment based on anticipated revenue, under normal conditions. This includes installations of service to new homes, replacement of deteriorated yard lines, and replacement of lines damaged during excavation, provided prudent care was taken during such excavation.
3. Locate distribution mains and service lines, upon request, beginning January 1, 2001.
4. Perform periodic main and service line leakage surveys according to ONG policy.
5. Inspect and test ONG's piping system, as well as your piping system, for leakage or other purposes as necessary.
6. Repair any leaks on our service line and meter and replace them when necessary.
7. Make reasonable efforts to restore your yard, but ONG cannot be responsible for normal construction damages.

### **You, the owner, will:**

1. Provide a suitable location for the meter, away from potential hazards.
2. Grant ONG reasonable access to your property to install the service line and meter and to perform maintenance and repair.
3. Be responsible for any extraordinary construction costs, such as replacing pavement, patios, and decks, modifying your house piping to meet local building codes, excavating in hard rock or frozen ground, installing footage of service line, or installing a service line greater than 1-1/4" diameter.
4. Be responsible for any additional lines to gas grills, gas lights, additional buildings, etc., as well as for any yard line you might need to install between the meter and your home.
5. Advise ONG if there are any changes on, or to, your property, that might place the meter in a potentially hazardous situation.
6. Notify ONG prior to building any permanent structures over the service line.
7. Be required to pay for any relocation of ONG's service line or meter due to your construction.
8. Refrain from enclosing the meter or any portion of ONG's aboveground piping.

**YOU MAY REQUEST AN ALTERNATE METER LOCATION AWAY FROM THE BUILDING.** You will, however, be responsible for the installation and maintenance of the line from the meter to the building. ONG will still respond to requests to locate your yard line and perform leakage surveys on the line.

Our goal is to provide you with safe, reliable gas service. Please call if I can be of further service.

ONG Representative \_\_\_\_\_

Phone Number \_\_\_\_\_

Friday, February 18, 2011

FORM 1222 (10.21.2005)

DATE SERVICE REQUIRED

REMARKS OR SPECIAL REQUESTS? ☐ NO ☐ YES (See Remarks Below)

JOB ORDER NO.

APPLICATON NUMBER

DATE

ATLAS PAGE NO.

WALL MAP NO.

The extension of ONG's system has been requested to serve the following:

LEGAL DESCRIPTION OF PROPERTY

SECTION 14

TOWNSHIP 14N

RANGE 4W

ADDITION / PROJECT NAME

LOT(S)

BLOCK(S)

Plat Attached

Plot Plan Attached

Individual Legal(s) Attached

Other: Atlas Page attached

DEVELOPER'S OR OWNER'S NAME

PHONE NO.

MAILING ADDRESS

PLUMBING CONTRACTOR

PHONE NO.

ARCHITECT / ENGINEER

PHONE NO.

APARTMENT COMPLEX, NO. UNITS

DUPLEX, NO. UNITS

LOAD DESCRIPTION: INDUSTRIAL / COMMERCIAL

☒ COMMERCIAL

1 Number of Meters

☐ INDUSTRIAL

0.3 Pressure Required (psig)

Number, Type & Btu of equipment to be installed:

Total Connected Load Dth/Hour

Maximum Daily Quantity (MDQ)

Total Annual Dth

Total Adjusted Gross Revenue

AGR if above is not to be used

Rate Schedule (1st Year)

Service Line / Meter Costs

1st Year

2nd Year

3rd Year

X 200-LCI

291-T

391-T

0.000

0.000

0.000

0.00

0.00

0.00

0

0

0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

LOAD DESCRIPTION: RESIDENTIAL

AVERAGE SQUARE FEET LIVING AREA

1800

Dth

AGR

NUMBER OF HOMES (Added each year)

1st Year

2nd Year

3rd Year

Heating Only

48

\$203.84

0

0

0

Heating & Water Heating

73

\$253.76

0

0

0

Heat, Water Heating, & Cooking

77

\$258.23

0

0

0

Electric Heat Pump / Gas Backup

23

\$153.92

0

0

0

Other

85

\$260.12

0

0

0

Service Line / Meter Costs (each)

\$500.00

0

0

0

1st Year

2nd Year

3rd Year

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

REMARKS / SPECIAL REQUESTS:

CUMMULATIVE PEAK Dth/Hour

CUMMULATIVE TOTAL Dth/Year

ALLOWED TOTAL REVENUE

ALLOWED TOTAL SERVICE LINE COSTS

TOTAL LINE EXTENSION FOOTAGE

MAIN LINE EXTENSION COST

TOTAL LINE EXTENSION COST

AVERAGE COST PER FOOT

MAXIMUM ALLOWABLE INVESTMENT

CUSTOMER CO-PAYMENT

0.000

0

\$0

\$0

0

\$0

\$0

\$0.000

\$0

\$0

0.000

0

\$0

\$0

2" Estimate

2" Estimate

2" Estimate

2" Estimate

X Co-Pay Based on Total Cost

Co-Pay Based on 2" Estimate

0.000

0

\$0

\$0

0

\$0

\$0

\$0.000

SUBMITTED BY

APPROVED BY

Friday, February 18, 2011

**SERVICE LINE COST AND AGREEMENT**

FORM 1930 (2/2004)

|                        |                     |               |  |
|------------------------|---------------------|---------------|--|
| SERVICE ADDRESS        |                     | ACCOUNT NO.   |  |
|                        |                     |               |  |
| TENANT NAME            | DAY PHONE           | EVENING PHONE |  |
|                        |                     |               |  |
| OWNER NAME             | DAY PHONE           | EVENING PHONE |  |
|                        |                     |               |  |
| <b>BILLING ADDRESS</b> | STREET ADDRESS      |               |  |
|                        | CITY/STATE/ZIP CODE |               |  |

| COST CALCULATION  |                                |  |          |
|---|--------------------------------|--|----------|
| Total Length: _____ Ft.   | <b>SERVICE LINE COST</b>       | ONG Labor / Materials                                | \$0.00   |
| Home Size _____ Sq. Feet  | Labor (Manhours) _____ 0 Hours | Concrete Cut   | \$0.00   |
| Heating Only <input checked="" type="checkbox"/>                    | Pick-Up, Group 4 _____ 0 Hours | Other  | \$0.00   |
| Heat & Water Heat <input checked="" type="checkbox"/>               | Pick-Up, Group 6 _____ 0 Hours | Other  | \$0.00   |
| Heat, Water, & Cooking <input checked="" type="checkbox"/>          | 2-Ton w/Trailer _____ 0 Hours  | Other  | \$0.00   |
| Electric Heat Pump / Gas Backup <input checked="" type="checkbox"/> | Backhoe _____ 0 Hours          | Other  | \$0.00   |
| Other _____ 100 Dth <input checked="" type="checkbox"/>             | Pipe - 1/2" _____ 0 Feet       | Other  | \$0.00   |
|   | Pipe - 3/4" _____ 0 Feet       | Other  | \$0.00   |
| <b>COMMERCIAL LOAD</b> <input checked="" type="checkbox"/>          | Pipe - 1 1/4" _____ 0 Feet     | Other  | \$0.00   |
| Total Load Dth/Hr _____ 1.500                                       | Pipe - 2" _____ 0 Feet         | Other  | \$0.00   |
| Max Daily (MDQ) _____ 15.00   | Pipe - 4" _____ 0 Feet         | Other  | \$0.00   |
| Total Annual Dth _____ 1,500  |                                |  |          |
| Number of Meters _____ 0  |                                |  |          |
| <b>FITTINGS</b>   | <b>METER INSTALLED COST</b>    | <b>CONSTRUCTION COST</b>                             | \$0.00   |
| Excess Flow Valves (EFV) _____ 0                                    | Meter - 250 _____ 0            | <b>LESS ALLOWABLE REVENUE CREDIT</b>                 | \$424.73 |
| Tapping Tee 2" x 3/4" _____ 0                                       | Meter - AL 425 _____ 0         | <b>PLUS CREDIT</b>                                   | \$300.00 |
| Tapping Tee 4" x 3/4" _____ 0                                       | Meter - AL 800 _____ 0         | <b>LIHEAP QUALIFIED Yes</b> <input type="checkbox"/> | \$0.00   |
| Tee, Service, Trans 1"x3/4" _____ 0                                 | Meter - AL 1000 _____ 0        | <b>TOTAL OWNER COST**</b>                            | \$0.00   |
|   | Meter - 3M _____ 0             | <b>LESS PAYMENT RECEIVED</b>                         | \$0.00   |
|   | Meter - 5M _____ 0             | <b>REMAINING BALANCE</b>                             | \$0.00   |

\* An experienced construction employee should estimate extraordinary construction barriers or pipe size requirements larger than 1 1/4 inch.

**FINANCE AGREEMENT**

\*\* If the Total Owner cost exceeds \$300.00, the owner may make a downpayment of \$100.00, and pay the remaining balance in installments for a period not to exceed 12 months. The monthly installments shall be equal to the greater of 1/12 of the remaining balance owed or \$50.00. If owner pays less than the Total Owner Cost at the time of signing this agreement, owner shall be deemed to have elected the monthly payment option. Any payment obligation will be added to owner's gas bill.

**SERVICE LINE AGREEMENT**

The undersigned property owner ("Owner"), \_\_\_\_\_ has authorized Oklahoma Natural Gas Company ("Company") to install a service line or replace the Owner's existing service line and/or yardline and to place the gas measurement equipment on the Owner's property.

The Company and the Owner understand and agree that:

- Owner has received and read a copy of the Company's New Service Line Policy Explanation, which explains the Company's and Owner's rights and responsibilities regarding ownership, maintenance, and repair of service lines and meters.
- Owner agrees to provide the Company appropriate access to Owner's premises for the purpose of installing, maintaining, and/or repairing service lines and meters.
- The Company will install measurement equipment at a suitable site on the Customer's premise, which normally will be located at the building wall, but may be located at another mutually agreed-upon site. Owner and Company agree that the measurement equipment shall be located at the following location:

LOCATION DESCRIPTION: \_\_\_\_\_

**OWNER(s)**

**OKLAHOMA NATURAL GAS COMPANY**

DATE

DATE

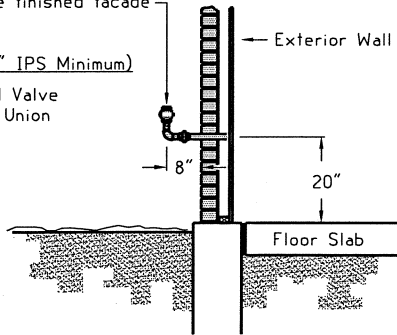
**NEW CONSTRUCTION**

Rev. Date: 09/28/04

Customer Convenience Valve should extend no more than 8" from the finished facade

Material List: (1" IPS Minimum)

- 1) Full Port Ball Valve
- 2) Ground Joint Union
- 3) 90° Elbow
- 4) Nipples
- 5) Plug



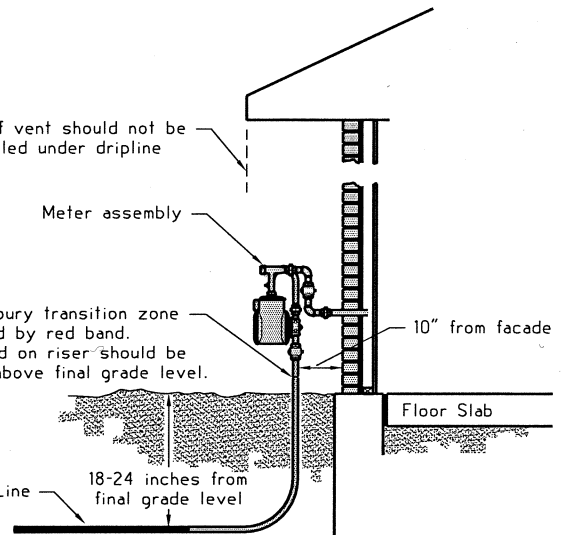
**Customer Gas Piping Location**  
**Figure G-2401.5a**

Relief vent should not be installed under dripline

Meter assembly

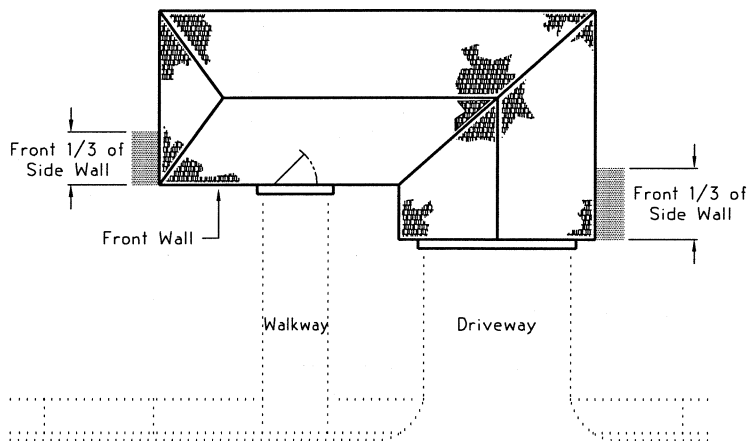
Do not bury transition zone indicated by red band. Red band on riser should be set 6" above final grade level.

Service Line 18-24 inches from final grade level

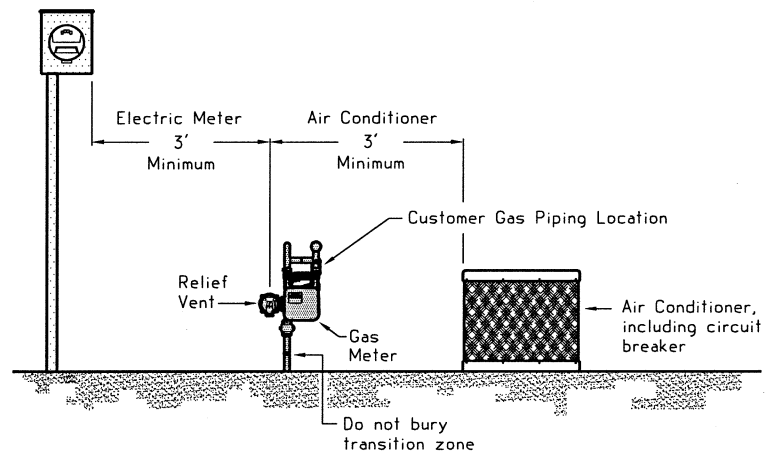


**Customer Gas Piping Location**  
**Figure G-2401.5b**

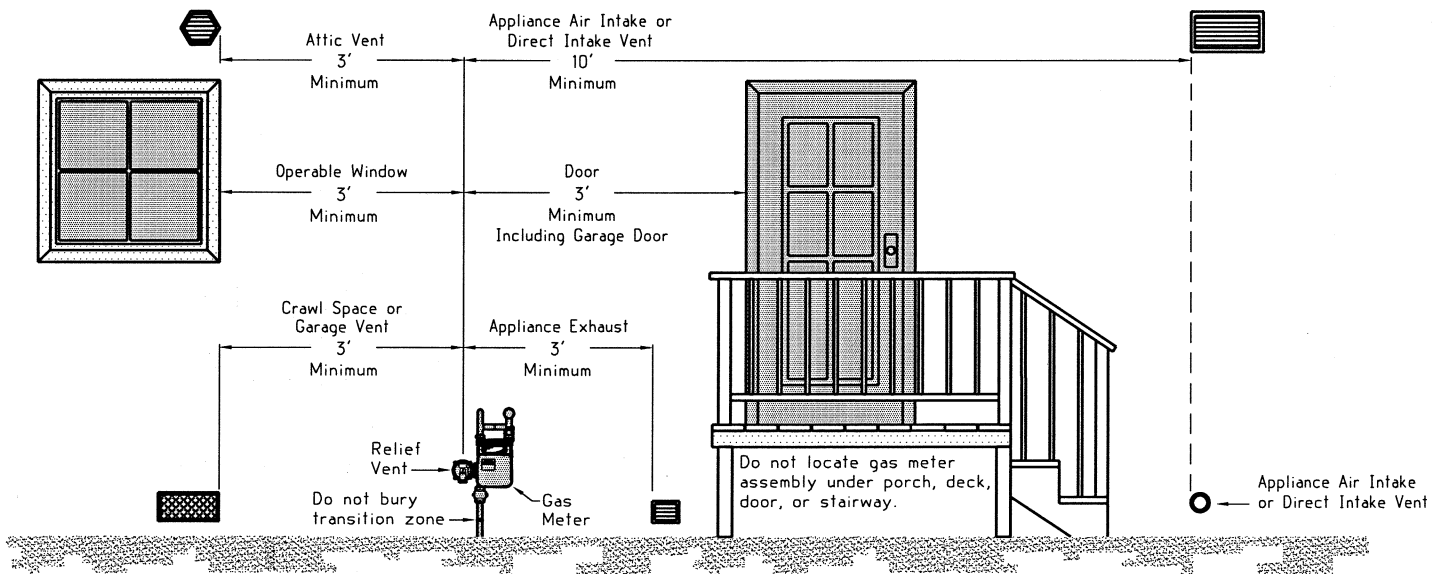
The normal location of the meter assembly shall be within the front 1/3 of either side wall, typically 3 to 10 feet from the front of the structure.



**Meter Location**  
**Figure G-2401.5c**



**Gas Meter Clearances**  
**Figure G-2401.5d**



**Gas Meter Clearances**  
**Figure G-2401.5e**



2106-04

Form 789

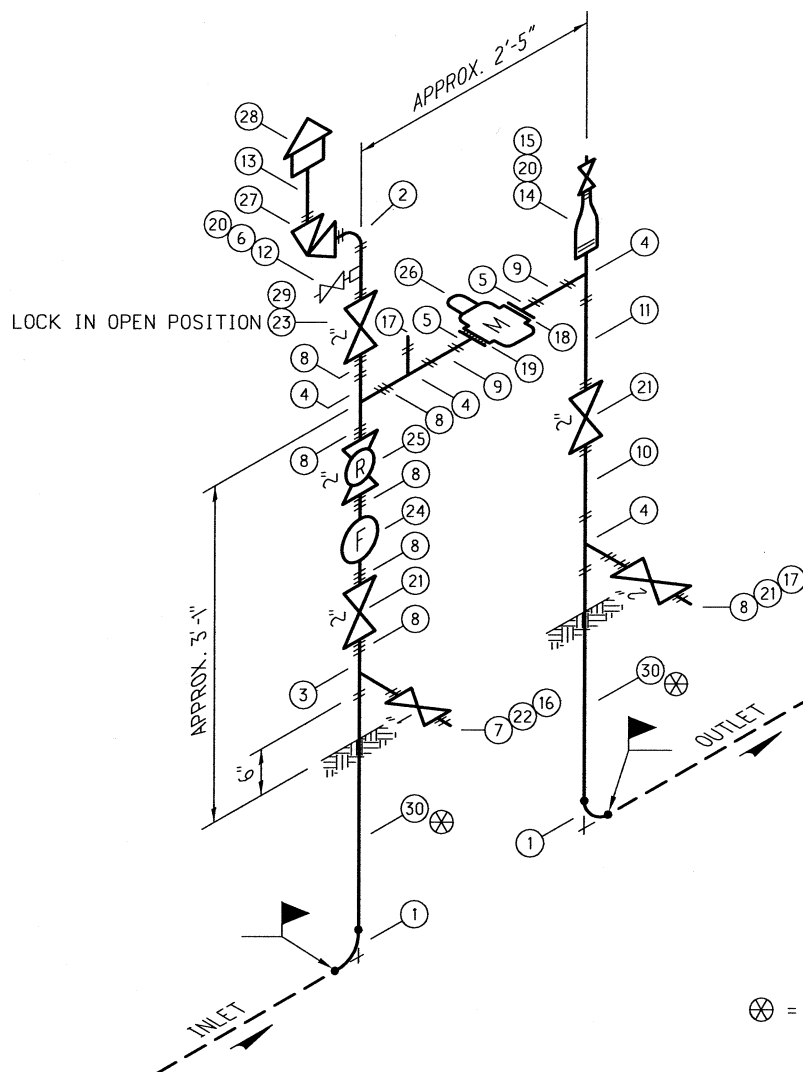
## GOSM - Standard Drawings Manual

Subject: **Rotary Meter Setting, MP (60 Psig and Less) Inlet Design**  
**3-M Meter, Measurement via Oz or PCI Index, Threaded Outlet**

Issued: 03-01-97

Revised: 12-22-04

| ITEM | QTY | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                  | ITEM | QTY   | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                                  |
|------|-----|-------------|---|------|-------|-------------|---|
| 1    | 2   | 2"          | ELL, STD, SMLS. B, 90° LR                         | 17   | 2     | 2"          | PLUG, PIPE, STEEL   |
| 2    | 1   | 2"          | ELL, STREET, M.I., 90°, 150# W.P. (Sc.)           | 18   | 1     | 2"          | GASKET, NON-ASBESTOS, ANSI 150                                    |
| 3    | 1   | 2"x2"x1"    | TEE, REDUCING, M.I., 150# W.P. (Sc.)              | 19   | 1     | 2"          | INSULATING SET, ANSI 150, 285# W.P.                               |
| 4    | 4   | 2"          | TEE, STD, M.I., 150# W.P. (Sc.)                   | 20   | 2     | 1/2"        | VALVE, BALL, 1000# W.P. MIN. (Sc.)                                |
| 5    | 2   | 2"          | FLANGE, FF FLG'D, ANSI 150, 285# W.P. (Sc.)       | 21   | 3     | 2"          | VALVE, BALL or NON-LUB. PLUG, 175# W.P. MIN. (Sc.)                |
| 6    | 1   | 1/2"x2 1/2" | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 22   | 1     | 1"          | VALVE, BALL or NON-LUB. PLUG, FULL CAPACITY, (Sc.) 175# W.P. MIN. |
| 7    | 1   | 1"x3"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 23   | 1     | 2"          | VALVE, BALL or NON-LUB. PLUG, FULL CAPACITY, (Sc.) 175# W.P. MIN. |
| 8    | 7   | 2"x3"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 24   | 1     | 2"          | FILTER, 175# W.P. MIN. (Sc.)                                      |
| 9    | 2   | 2"x6"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 25   | 1     | 2"          | REGULATOR, SERVICE (Sc.) (SIZE ON FORM 761)                       |
| 10   | 1   | 2"x10"      | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 26   | 1     | 2"          | METER, ROTARY, 3M-175 w/ COATED BOLTS, 175# W.P. MIN.             |
| 11   | 1   | 2"x12"      | NIPPLE, STD, STEEL, 500# W.P. (Sc.)               | 27   | 1     | 2"          | VALVE, RELIEF (Sc.) (SIZE ON FORM 761)                            |
| 12   | 1   | 2"x6"       | NIPPLE, TEST, STEEL (Sc.) w/ 1/2" COUPLING & PLUG | 28   | 1     | 2"          | VENT CAP  |
| 13   | 1   | 2"x6"       | NIPPLE, STD, SMLS. B, 800# W.P., T.O.E.           | 29   | 1     | -           | LOCKING DEVICE  |
| 14   | 1   | 2"x1/2"     | NIPPLE, SWAGE, X-HVY, SMLS. B, 2000# W.P. (Sc.)   | 30   | 9 FT. | 2 3/8" O.D. | PIPE, 3.65# (0.154" W.T.), SMLS. B, FBE COATED, PRETESTED         |
| 15   | 1   | 1/2"        | PLUG, PIPE, STEEL                                 |      |       |             |   |
| 16   | 1   | 1"          | PLUG, PIPE, STEEL                                 |      |       |             |   |





2106-06

Form 789

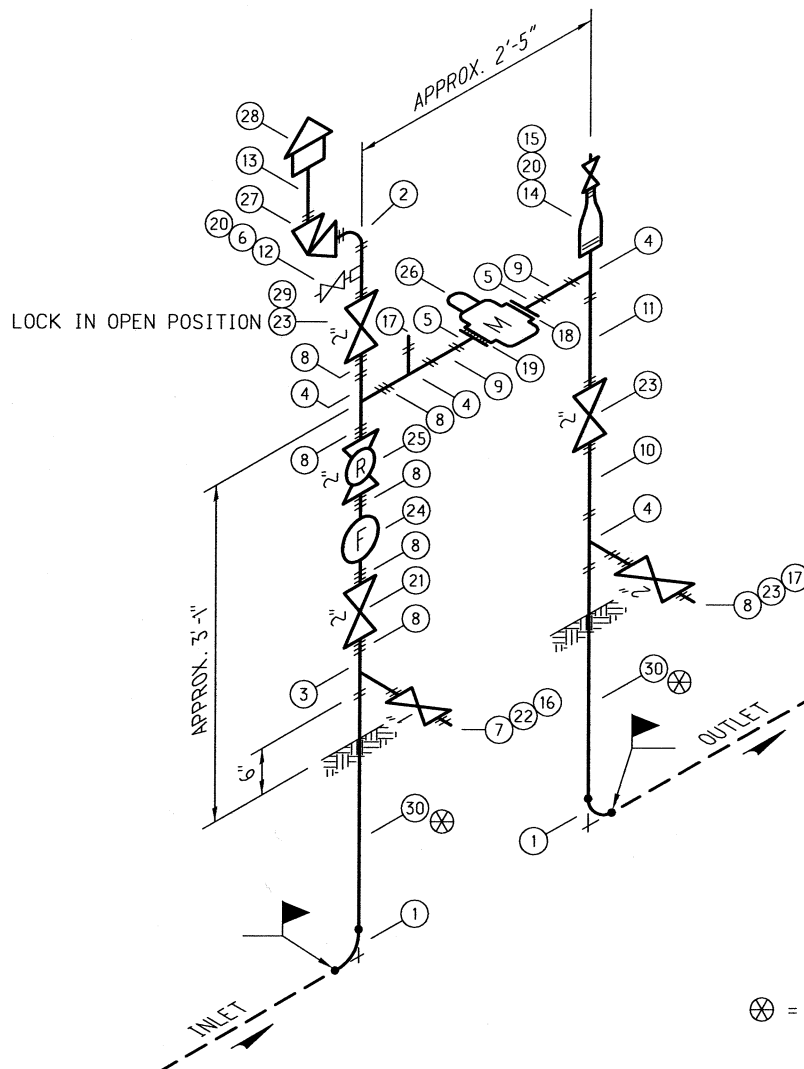
## GOSM - Standard Drawings Manual

Subject: **Rotary Meter Setting, MP (60 Psig and Less) Inlet Design**  
**5-M Meter, Measurement via Oz or PCI Index, Threaded Outlet**

Issued: 03-01-97

Revised: 12-22-04

| ITEM | QTY | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                      | ITEM | QTY   | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                                  |
|------|-----|-------------|---|------|-------|-------------|---|
| 1    | 2   | 2"          | ELL, STD, SMLS. B, 90° LR                             | 17   | 2     | 2"          | PLUG, PIPE, STEEL   |
| 2    | 1   | 2"          | ELL, STREET, M.I., 90°, 150# W.P. (Sc.)               | 18   | 1     | 3"          | GASKET, NON-ASBESTOS, ANSI 150                                    |
| 3    | 1   | 2"x2"x1"    | TEE, REDUCING, M.I., 150# W.P. (Sc.)                  | 19   | 1     | 3"          | INSULATING SET, ANSI 150, 285# W.P.                               |
| 4    | 4   | 2"          | TEE, STD, M.I., 150# W.P. (Sc.)                       | 20   | 2     | 1/2"        | VALVE, BALL, 1000# W.P. MIN. (Sc.)                                |
| 5    | 2   | 2"x7 1/2"   | FLANGE, REDUCING, FF FLG'D, ANSI 150, 285# W.P. (Sc.) | 21   | 1     | 2"          | VALVE, BALL or NON-LUB. PLUG, 175# W.P. MIN. (Sc.)                |
| 6    | 1   | 1/2"x2 1/2" | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 22   | 1     | 1"          | VALVE, BALL or NON-LUB. PLUG, FULL CAPACITY, (Sc.) 175# W.P. MIN. |
| 7    | 1   | 1"x3"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 23   | 3     | 2"          | VALVE, BALL or NON-LUB. PLUG, FULL CAPACITY, (Sc.) 175# W.P. MIN. |
| 8    | 7   | 2"x3"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 24   | 1     | 2"          | FILTER, 175# W.P. MIN. (Sc.)                                      |
| 9    | 2   | 2"x6"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 25   | 1     | 2"          | REGULATOR, SERVICE (Sc.) (SIZE ON FORM 761)                       |
| 10   | 1   | 2"x10"      | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 26   | 1     | 3"          | METER, ROTARY, 5M-175 w/ COATED BOLTS, 175# W.P. MIN.             |
| 11   | 1   | 2"x12"      | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 27   | 1     | 2"          | VALVE, RELIEF (Sc.) (SIZE ON FORM 761)                            |
| 12   | 1   | 2"x6"       | NIPPLE, TEST, STEEL (Sc.) w/ 1/2" COUPLING & PLUG     | 28   | 1     | 2"          | VENT CAP  |
| 13   | 1   | 2"x6"       | NIPPLE, STD, SMLS. B, 800# W.P., T.O.E.               | 29   | 1     | -           | LOCKING DEVICE  |
| 14   | 1   | 2"x1/2"     | NIPPLE, SWAGE, X-HVY, SMLS. B, 2000# W.P. (Sc.)       | 30   | 9 FT. | 2 3/8" O.D. | PIPE, 3.65# (0.154" W.T.), SMLS. B, FBE COATED, PRETESTED         |
| 15   | 1   | 1/2"        | PLUG, PIPE, STEEL                                     |      |       |             |   |
| 16   | 1   | 1"          | PLUG, PIPE, STEEL                                     |      |       |             |   |



Friday, February 18, 2011



2106-08

Form 789

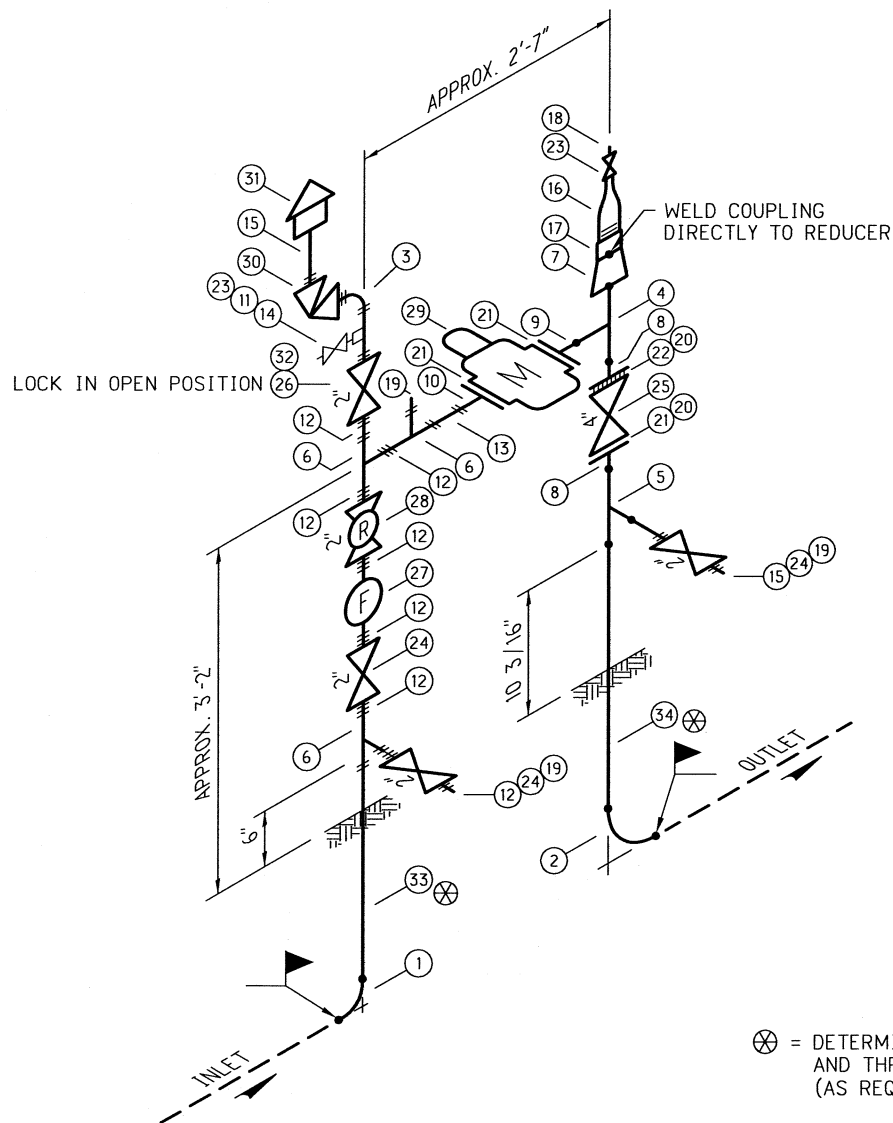
## GOSM - Standard Drawings Manual

Subject: **Rotary Meter Setting, MP (60 Psig and Less) Inlet Design**  
**11-M Meter, Measurement via Oz or PCI Index**

Issued: 03-01-97

Revised: 12-22-04

| ITEM | QTY | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                      | ITEM | QTY   | SIZE        | DESCRIPTION OF MATERIAL REQUIRED                                  |
|------|-----|-------------|---|------|-------|-------------|---|
| 1    | 1   | 2"          | ELL, STD, SMLS. B, 90° L.R.                           | 19   | 3     | 2"          | PLUG, PIPE, STEEL   |
| 2    | 1   | 4"          | ELL, STD, SMLS. B, 90° L.R.                           | 20   | 16    | 5/8"x3 3/4" | BOLT, STUD, w/ 2 HEX NUTS   |
| 3    | 1   | 2"          | ELL, STREET, M.I., 90°, 150# W.P. (Sc.)               | 21   | 3     | 4"          | GASKET, NON-ASBESTOS, ANSI 150                                    |
| 4    | 1   | 4"          | TEE, STD, SMLS. B                                     | 22   | 1     | 4"          | INSULATING SET, ANSI 150, 285# W.P.                               |
| 5    | 1   | 4"x4"x2"    | TEE, REDUCING, STD, SMLS. B                           | 23   | 2     | 1/2"        | VALVE, BALL, 1000# W.P. MIN. (Sc.)                                |
| 6    | 3   | 2"          | TEE, STD, M.I., 150# W.P. (Sc.)                       | 24   | 3     | 2"          | VALVE, BALL or NON-LUB. PLUG, 175# W.P. MIN. (Sc.)                |
| 7    | 1   | 4"x2"       | REDUCER, STD, SMLS. B                                 | 25   | 1     | 4"          | VALVE, BALL or NON-LUB. PLUG, RF FLG'D., 175# W.P. MIN.           |
| 8    | 2   | 4"          | FLANGE, WN RF, ANSI 150, 285# W.P.                    | 26   | 1     | 2"          | VALVE, BALL or NON-LUB. PLUG, FULL CAPACITY, (Sc.) 175# W.P. MIN. |
| 9    | 1   | 4"          | FLANGE, WN FF, ANSI 150, 285# W.P.                    | 27   | 1     | 2"          | FILTER, 175# W.P. MIN. (Sc.)                                      |
| 10   | 1   | 2"x9"       | FLANGE, REDUCING, FF FLG'D, ANSI 150, 285# W.P. (Sc.) | 28   | 1     | 2"          | REGULATOR, SERVICE (Sc.) (SIZE ON FORM 761)                       |
| 11   | 1   | 1/2"x2 1/2" | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 29   | 1     | 4"          | METER, ROTARY, 11M-175 w/ COATED BOLTS, 175# W.P. MIN.            |
| 12   | 7   | 2"x3"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 30   | 1     | 2"          | VALVE, RELIEF (Sc.) (SIZE ON FORM 761)                            |
| 13   | 1   | 2"x6"       | NIPPLE, STD, STEEL, 500# W.P. (Sc.)                   | 31   | 1     | 2"          | VENT CAP  |
| 14   | 1   | 2"x6"       | NIPPLE, TEST, STEEL (Sc.) w/ 1/2" COUPLING & PLUG     | 32   | 1     | -           | LOCKING DEVICE  |
| 15   | 2   | 2"x6"       | NIPPLE, STD, SMLS. B, 800# W.P., T.O.E.               | 33   | 5 FT. | 2 3/8" O.D. | PIPE, 3.65# (0.154" W.T.), SMLS. B, FBE COATED, PRETESTED         |
| 16   | 1   | 2"x1/2"     | NIPPLE, SWAGE, X-HVY, SMLS. B, 2000# W.P. (Sc.)       | 34   | 5 FT. | 4 1/2" O.D. | PIPE, 10.79# (0.237" W.T.), SMLS. B, FBE COATED, PRETESTED        |
| 17   | 1   | 2"          | COUPLING, F.S., 3000# W.P. (Sc.)                      |      |       |             |   |
| 18   | 1   | 1/2"        | PLUG, PIPE, STEEL                                     |      |       |             |   |



Friday, February 18, 2011



## OKLAHOMA NATURAL GAS CO.

EMERGENCY CONTACT LIST

FORT SILL

NOV. 2005

## PRIMARY CONTACTS

FOR EMERGENCIES DURING REGULAR WORKING HOURS 8:00 AM THRU  
: 5:00 PM, CALL 1-800-551-6601 OR 1-405-247-2345 OR THE FORT SILL  
OFFICE: 580 353-1985

## 24 HOUR DISPATCH

ONG CUSTOMER SERVICE: 1-800-664-5463 or 1-800-ong-line

FOR AFTER HOUR EMERGENCIES CALL: 1-800-551-6601  
or  
1-800-458-4251

## SECONDARY CONTACTS IN ORDER:

## ROBERT SIMS, MANAGER, FORT SILL:

OFFICE: 580-353-1985  
CELL : 580-695-0499  
HOME: 580-588-3333

## DAVID WILES: OPERATING SUPERVISOR 2

CELL: 580-515-4726  
HOME: 405-247-9871  
OFFICE: 405-247-1218

## STEVE GIBSON: OPERATING SUPERVISOR 4

OFFICE: 405-247-1222 IF NO ANSWER : 405-247-1229  
CELL: 580-515-1507  
HOME: 405-247-2203

## DAVID ALLEN: MEASUREMENT

OFFICE: 405-247-1223  
CELL: 580-774-8708  
HOME: 405-966-2351  
PAGER: 405-967-0063

## RON TAYLOR, AREA MANAGER

OFFICE: 405-247-1231  
CELL: 405-641-5969  
HOME: 405-247-6709

## **Appendix DD**

### **Water Quality Analysis**

Section: Appendix DD  
What does this report mean?

W9126G-11-R-0053  
Page 669 of 1356

The report shows the results of our water quality analyses. Every regulated contaminant that was detected in the water, even in the most minute traces, is listed here. The report contains the name of each substance, the highest level allowed by regulation (MCL), and the ideal goals for public health, the amount detected, the usual sources of such contaminants, footnotes explaining our finding, and a key to units of measurements.

**Maximum Contaminant Level or MCL:** The highest level of a contaminant allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

**Maximum Contaminant Level Goal or MCLG:** The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

**Action Level:** The concentration of a contaminant which, if exceeded, triggers a treatment or other requirement, a water system must follow.

**Treatment Technique:** A required process intended to reduce the level of a contaminant in drinking water.

**Turbidity:** Measurement of the cloudiness of the water. It is monitored because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants.

**Definitions:**  
Pci/L=Pico curies per liter (radioactivity measurement) MCL=Maximum Contaminant Level ppm=parts per million or milligrams per liter (mg/L)  
MCLG=Maximum Contaminant Level Goal TT=Treatment Technique ppb=parts per billion or micrograms per liter (ug/L)  
NTU=Nephelometric Turbidity units AL=Action Level BPQL=Below practical quantitive limits

| 2005 WATER QUALITY DATA<br>REGULATED AT THE TREATMENT PLANT       |             |       |   |       |  |           |   |       |       |           |       |       |
|---|-------------|-------|---|-------|--|-----------|---|-------|-------|-----------|-------|-------|
| CONTAMINANT   | DATE TESTED | UNIT  | MCL   | MCLG  | DETECTED LEVEL                         | RANGE     | MAJOR SOURCE  |       |       | VIOLATION |       |       |
| MERCURY (INORGANIC)   | 10/31/2005  | ppb   | 2   | 2     | BPQL                                   | NONE      | Erosion of natural deposit  |       |       | NO        |       |       |
| FLUORIDE  | 11/07/2005  | ppm   | 4   | 4     | 1.36                                   | .12-1.36  | Erosion of natural deposit<br>Treatment addition  |       |       | NO        |       |       |
| ARESNIC   | 10/31/2005  | ppb   | 10  | 0     | <2                                     | NONE      | Erosion of natural deposit  |       |       | NO        |       |       |
| SELENIUM  | 10/31/2005  | ppb   | 50  | 50    | <1                                     | NONE      | Erosion of natural deposit  |       |       | NO        |       |       |
| NITRATE-NITRITE   | 10/2005     | ppm   | 10  | 10    | <.10                                   | NONE      | Runoff from fertilizer use; leaching from<br>spectic tanks, sewage, erosion of natural<br>deposit   |       |       | NO        |       |       |
| ALPHA EMITTERS  | 2002        | pCi/L | 15  | 0     | .3025                                  | .18- .51  | Erosion of natural deposits   |       |       | NO        |       |       |
| BETA/PHOTON EMITTERS  | 2002        | pCi/L | 50  | 0     | 2.93                                   | 2.66-3.22 | Decay of natural and man-made deposits  |       |       | NO        |       |       |
| TURBIDITY   | 8/12/2005   | NTU   | <u>TT=.3NTU</u><br>TT=% OF<br>SAMPLES <.3<br>NTU  | 0     | <u>.65</u><br>100%                     | NONE      | Soil runoff   |       |       | NO        |       |       |
| BARIUM  | 10/31/2005  | ppm   | 2   | 2     | .082                                   | NONE      | Discharge of drilling wastes; discharge<br>from metal refineries; Erosion of natural<br>deposit   |       |       | NO        |       |       |
| TOTAL ORGANIC CARBON*<br>(results based on a yearly<br>avg ratio) | 12/2005     | ppm   | TT=Annual avg<br>% removal based<br>on raw water<br>TOC levels and<br>alkalinity. To be<br>in compliance<br>yearly avg ratio<br>must be 1 or<br>greater than 1. | N/A   | SEE BELOW<br>yearly avg ratio:<br>1.02 |           | Naturally present in environment.<br>Has no health effects. Provides a medium<br>for the formation of disinfection by<br>products, including Trihalomethanes and<br>Haloacetic Acids. |       |       | YES       |       |       |
| * MONTH   | 1/05        | 02/05 | 03/05   | 04/05 | 05/05                                  | 06/05     | 07/05   | 08/05 | 09/05 | 10/05     | 11/05 | 12/05 |
| SOURCE WATER TOC  | 4.53        | 4.93  | 4.73  | 4.61  | 5.55                                   | 4.43      | 4.53  | 4.41  | 4.31  | 4.52      | 4.79  | 4.52  |
| SOURCE WATER ALKALINITY   | 123         | 129   | 134   | 131   | 131                                    | 137       | 118   | 108   | 107   | 112       | 118   | 125   |
| FINISHED WATER TOC  | 3.42        | 3.37  | 3.22  | 3.46  | 4.46                                   | 3.36      | 3.18  | 2.99  | 2.87  | 2.96      | 3.31  | 3.50  |
| Required % removal  | 25%         | 25%   | 25%   | 25%   | 25%                                    | 25%       | 35%   | 35%   | 35%   | 35%       | 35%   | 25%   |
| Actual % removal  | 25%         | 32 %  | 32 %  | 25%   | 20%                                    | 24%       | 30%   | 32%   | 33%   | 35%       | 31%   | 23%   |

| REGULATED IN THE DISTRIBUTION SYSTEM |                     |            |                          |      |                         |                    |                                      |  |           |  |  |
|--------------------------------------|---------------------|------------|--------------------------|------|-------------------------|--------------------|--------------------------------------|--|-----------|--|--|
| CONTAMINANT                          | DATE TESTED         | UNIT       | MCL                      | MCLG | DETECTED LEVEL          | RANGE OF DETECTION | MAJOR SOURCE                         |  | VIOLATION |  |  |
| TOTAL COLIFORMS                      | 12/2005 (Monthly)   | % Positive | No more than 5% positive | 0    | 0                       | <1 % positive      | Naturally present in the environment |  | NO        |  |  |
| TOTAL TRIHALOMETHANES                | 12/2005 (quarterly) | ppb        | 80 Avg                   | 0    | 63.18 (highest quarter) | 31.78-63.18        | by-product of chlorination           |  | NO        |  |  |
| HALOACTIC ACIDS (HAA5)               | 12/2005 (quarterly) | ppb        | 60 Avg                   | 0    | 13.56 (highest quarter) | <10-19.00          | by-product of chlorination           |  | NO        |  |  |
| BROMATE                              | 12/2005 (monthly)   | ppb        | 10                       | 0    | 174 (highest month)     | <5-174             | by-product of ozone disinfection     |  | YES       |  |  |

| REGULATED AT THE CUSTOMERS TAP |             |      |            |      |                |            |   |  |           |  |  |
|--------------------------------|-------------|------|------------|------|----------------|------------|---|--|-----------|--|--|
| CONTAMINANT                    | DATE TESTED | UNIT | MCL        | MCLG | DETECTED LEVEL | RANGE      | MAJOR SOURCE                            |  | VIOLATION |  |  |
| COPPER                         | 8/2003      | ppm  | AL=1.3 ppm | 1.3  | 1.1            | 0 sites>AL | Corrosion of household plumbing systems |  | NO        |  |  |
| LEAD                           | 8/2003      | ppb  | AL=15 ppb  | 0    | 3.1            | 0 sites>AL | Corrosion of household plumbing systems |  | NO        |  |  |

**SPECIAL INFO AVAILABLE:** Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone transplants, people with HIV/Aids or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the safe drinking water hotline 1-800-426-4791. Your water supply is safe in ALL water quality parameters. If you have any questions, please contact the Water Treatment Plant at 580-529-2703.

CITY OF LAWTON WATER TREATMENT PLANT

2005 WATER QUALITY REPORT

BILLING/CUSTOMER SERVICE INFORMATION: (580) 581-3308

W EB SITES: [www.cityof.lawton.ok.us](http://www.cityof.lawton.ok.us) or [www.epa.gov/safewater/](http://www.epa.gov/safewater/)

WATER QUALITY

The City of Lawton is committed to providing residents with a safe and reliable supply of high-quality drinking water. This annual **A Consumer Confidence Report** required by the Safe Drinking Water Act (SDWA), tells you where your water comes from, how the treated water quality compares to the required quality standards and other things you should know about drinking water.

CRYPTOSPORIDIUM

Cryptosporidium is a microscopic organism that when ingested can result in diarrhea, fever and other gastrointestinal symptoms. This organism is found in most lakes and streams. Cryptosporidium comes from animals and humans whom are the carriers of the organism and have contact with the source water supplies. Cryptosporidium is eliminated by effective treatment combinations including filtration, sedimentation and disinfection.

TRIHALOMETHANES  
BY-PRODUCTS OF  
CHLORINATION

Million of people every year are affected by microbial contaminants (bacteria) in drinking water due to inadequate disinfection of the water supply. This is a real problem. AMicrobial risks are real. Chlorination of your water system is essential in order to protect public health. However, when chlorine is introduced into untreated water, chlorine and naturally occurring organics in the water form by products called TRIHALOMETHANES (THMS). Some people who drink water containing THMS in excess of the MCL over many years may experience problems with their liver, kidneys or central nervous system, and may have an increased risk of cancer.

TOC VIOLATIONS

During the first, second and third quarter of 2005 the Water Treatment Plant was out of compliance for the required TOC removal. TOC has no health effects; however, TOC can provide a medium for the formation of disinfectant by products. The Water Treatment Plant is now in full compliance with this requirement.

BROMATE MCL VIOLATION

Our water system recently violated a drinking water standard. Although this is not an emergency, as our customers, you have a right to know what happened, what you should do, and what we are doing to correct this situation. The average of the eight bromate samples submitted by the City of Lawton Water Treatment Plant for the twelve months of 2005 is .033 mg/L. This value exceeds the MCL of .010 mg/L for bromate; therefore, the WTP is in violation for exceeding the MCL for bromate.

*The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that bromate is a health concern at certain high levels of exposure. Bromate is formed as a by-product of ozone disinfection of drinking water. Ozone reacts with naturally occurring bromide in water to form bromate. The EPA has set a drinking water standard to limit exposure to bromate.*

WHAT SHOULD I DO? **You do not need to use an alternative (e.g. bottled) water supply.** However, if you have specific health concerns, consult your doctor.

WHAT DOES THIS MEAN? This is not an immediate risk. If it had been, you would have been notified immediately. However, some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of getting cancer.

WHAT HAPPENED? WHAT IS BEING DONE?

The water treatment plant will try to control Bromate formation by lowering the pH of the water through the ozonization process and by lowering the ozone concentration used for disinfection.

SOURCE WATER PROTECTION

The City of Lawton is in the process of putting together a source water protection program. This is an ongoing effort to identify sources of possible pollution.

As these sources are identified, we will work to eliminate this pollution or to minimize its effect on the water supply. Your help is needed for this program to succeed. For more information, please visit [www.epa.gov/owow/watershed](http://www.epa.gov/owow/watershed).

**Sources of pollution on the Lake Lawtonka or Lake Ellsworth reservoirs or their watershed should be reported to the Water Treatment plant by calling 580-529-2703**

Please use care when using pesticides or herbicides as over application can runoff into the reservoir. Septic tanks should be serviced regularly to keep nutrients such as nitrogen and phosphorus out of the reservoir.

MONITORING REQUIREMENT NOT MET

Our water system violated a drinking water standard over the past year. Even though this was not an emergency, as our customers, you have a right to know what happened and what we did to correct this situation.

*We are required to monitor your drinking water for specific contaminants on a regular basis. The results of regular monitoring are an indicator of whether or not our drinking water meets health standards. During September –December 2005 we did not monitor or did not complete all monitoring for Bromate and therefore cannot be sure of the quality of our drinking water during that time.*

WHAT SHOULD I DO?

There is nothing you need to do at this time.

WHAT HAPPENED? WHAT IS BEING DONE?

In the month of September 2005 the laboratory doing the WTP compliance analysis for Bromate lost its certification for this analysis. The WTP was notified of this in March 2006 and has started sending the monthly compliance sample to the ODEQ laboratory. The monthly analysis for Bromate for 6 months was performed by a laboratory that was not certified for that analysis and as such those results cannot be relied on for accuracy.

For more information, please contact David Herring at 580-529-2703.

*Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.*

WATER INFORMATION

**TOTAL WATER TREATED:** 6,632,700,000  
**DAILY AVG TREATED:** 18,171,781  
**MAX DAILY FLOW:** 28,100,000  
**WATER PUMPED FROM ELLSWORTH:** 2,850,728,000  
**WATER PUMPED FROM WAURIKA:** 35,099,000  
**TOTAL RAINFALL:** 20.84”  
**AVG ATMOSPHERIC TEMPERATURE:** 62 **WATER:** 63  
**PH RANGE:** 6.76-9.03  
**HARDNESS** 157 PPM OR 9.16 GRAINS/GAL  
**ALKALINITY:** 111 PPM  
**FLUORIDE:** .99 PPM  
**TURBIDITY:** .077 NTU

SOURCES OF WATER FOR THE CITY OF LAWTON

The water for the City of Lawton comes entirely from surface sources. The primary water supply is Lake Lawtonka. Lake Lawtonka has a watershed that covers approximately 92 square miles. Lake Ellsworth and Lake Waurika are the city’s secondary water supplies. The watershed for Lake Ellsworth covers approximately 249 square miles, while the Lake Waurika watershed covers 562 square miles. As water travels over the land’s surface or through the ground, it dissolves naturally occurring minerals and radioactive material, and can be polluted by animals or human activity. Contaminants that might be expected in untreated water include: biological contaminants, such as viruses and bacteria; inorganic contaminants, such as salts and metals; pesticides and herbicides; organic contaminants from industrial or petroleum use and radioactive materials. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. Presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the *U.S. Environmental Protection Agency* (EPA) *Safe Drinking Water Hotline at 1-800-426-4791*.

PRSRRT STD

US POSTAGE

PAID

PERMIT NO. 46

LAWTON OK

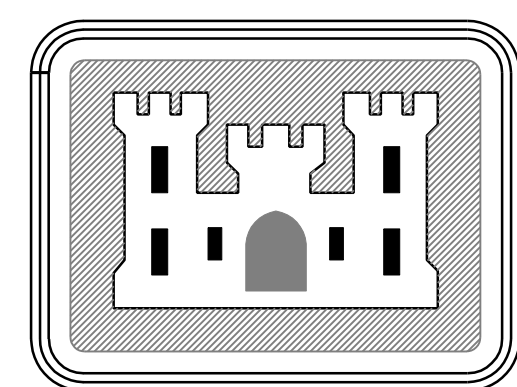
LAWTON WATER TREATMENT PLANT

PO BOX 27

MEDICINE PARK OK 73557

## **Appendix EE**

### **Infrastructure Drawings**



US Army Corps  
Of Engineers  
Tulsa District

# CENTRAL ISSUE FACILITY PRIMARY INFRASTRUCTURE

FORT SILL ARMY POST  
FORT SILL, OK

PDC: 65299                      FY: 10  
RFP NO.  
CONTRACT NO. W912BV-    -    -

## D

C

B

**A**

|   |  |
|---|--|
| SIGNATURES AFFIXED BELOW INDICATE OFFICIAL<br>RECOMMENDATION AND APPROVAL OF ALL DRAWINGS<br>IN THIS SET AS INDEXED ON THIS SHEET |  |
| REVIEWED BY:  |  |
| TITLE: CH. DESIGN BRANCH  |  |
| APPROVED BY:  |  |
| TITLE: CH. ENGR & CONST DIV. DATE:  |  |



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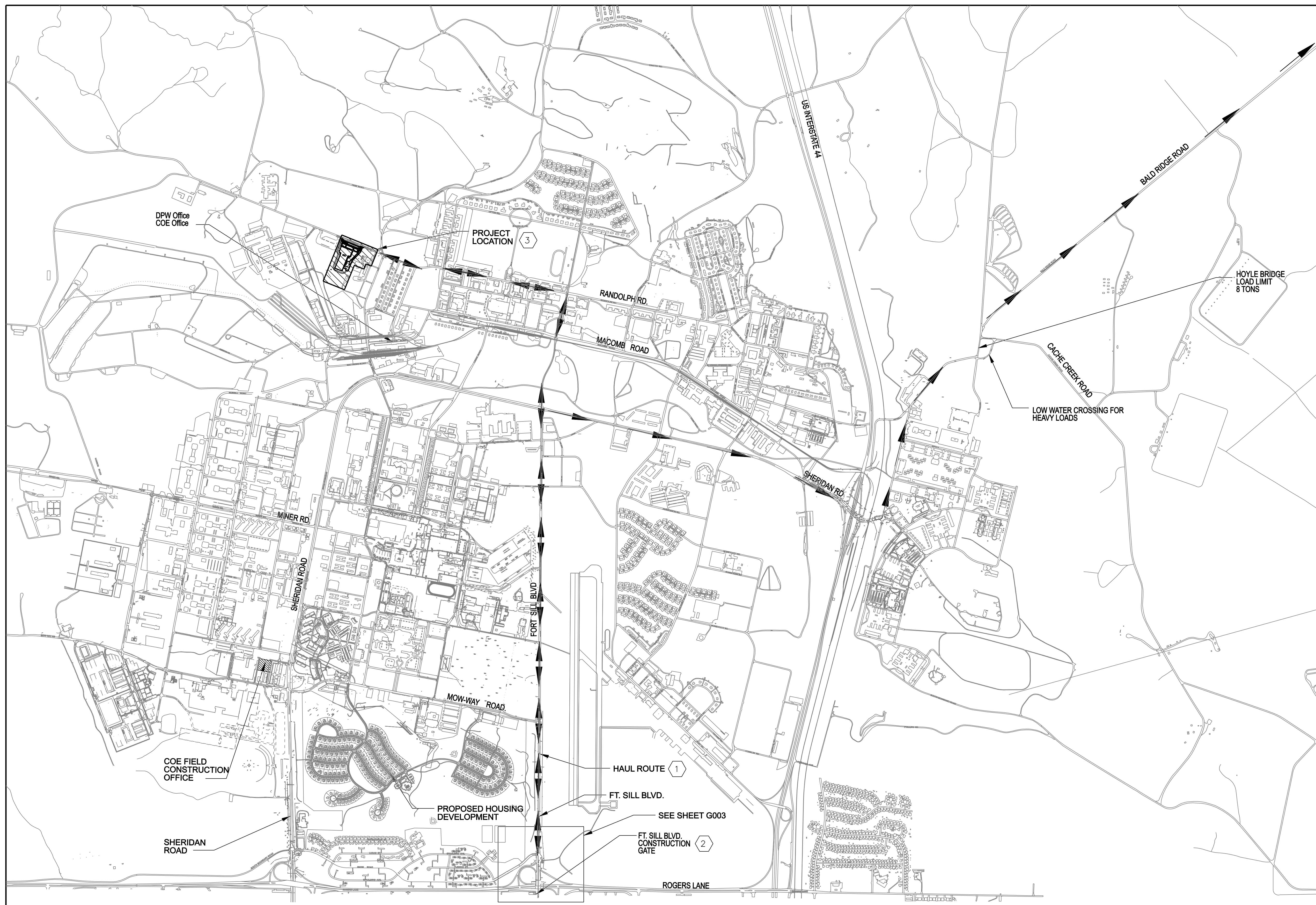
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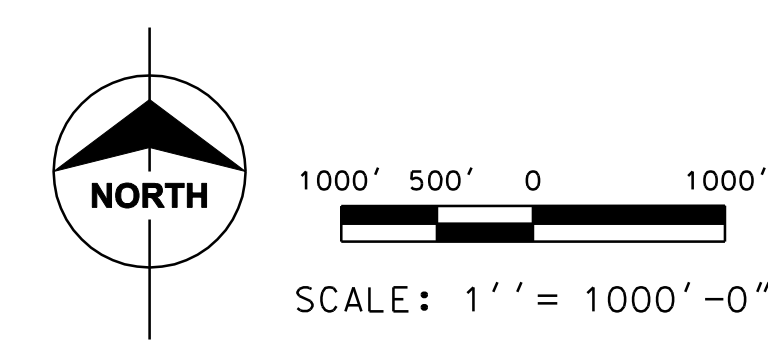
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- GENERAL PROJECT SCOPE NOTES:
- SITE ANALYSIS**  
THE PROJECT CONSISTS OF THE SITE PLANNING FOR A CENTRAL ISSUE FACILITY (CIF). THE CURRENT CENTRAL ISSUE FACILITY IS INADEQUATE AND SPREAD OUT ACROSS THE POST IN MULTIPLE BUILDINGS. THE DESIGN WORK IN THIS PROJECT CONSISTS OF CONSTRUCTING NEW PRIMARY INFRASTRUCTURE UTILITY SYSTEMS TO SUPPORT THE NEW FACILITY. CONSTRUCT NEW POV PARKING LOTS, ROADS AND SIDEWALKS. THE WORK INCLUDES THE CONSTRUCTION OF NEW WATER DISTRIBUTION MAINS, SEWER MAINS, GAS DISTRIBUTION MAINS, AND ELECTRICAL/COMMUNICATION DUCTBANKS. THERE WILL BE DEMOLITION AND RELOCATION OF PORTIONS OF THE EXISTING UTILITY SYSTEMS TO CLEAR THE SITE FOR NEW FACILITY CONSTRUCTION.
  - GRADING**  
THE GRADING PLAN WAS DEVELOPED FOR THE ENTIRE SITE AND WILL BE INCLUDED IN THE DESIGN/BUILD RFP DOCUMENTS. THE GRADING WILL HAVE A MINIMUM SLOPE OF 1 PERCENT FOR CONCRETE PAVEMENTS, 2 PERCENT FOR ASPHALT PAVEMENTS, MINIMUM 1 PERCENT FOR SIDEWALKS WITH A MAXIMUM OF 5 PERCENT, AND A MINIMUM 5 PERCENT FOR THE FIRST 10 FEET AROUND FACILITIES. ALL SIDEWALKS WILL BE DESIGNED WITH HANDICAP ACCESSIBLE RAMPS AT STREET INTERSECTIONS WITH CURB AND GUTTER.
  - STORM DRAINAGE**  
CONTRACTOR WILL BE RESPONSIBLE FOR MAINTAINING THE SITE IN ACCORDANCE WITH THE OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY STORMWATER POLLUTION PREVENTION MEASURES THROUGHOUT THE PROJECT DURATION. A NEW STORMWATER DETENTION POND WILL BE DESIGNED AND CONSTRUCTED TO CONTROL THE POST DEVELOPMENT RUNOFF SO AS NOT TO EXCEED THE PRE-DEVELOPMENT RUNOFF NEAR THE CENTRAL ISSUE FACILITY AREA. THE POND WILL CONSIST OF AN EARTH BERM WITH A DRAINAGE CULVERT AT THE BOTTOM TO DRAIN THE POND AT THE DESIGNED FLOW RATE WITHIN 48 HRS DEPENDING ON THE SIZE OF THE RAINFALL EVENT. THE POND WILL BE DESIGNED AS A DRY POND THAT WILL DRAIN EMPTY AFTER EACH RAINFALL EVENT AND WILL NOT RETAIN WATER FOR LONG PERIODS OF TIME. THE NEW CONSTRUCTION WILL REQUIRE THE REGRADING AND REROUTING OF SEVERAL SMALL DRAINAGE SWALES AROUND THE NEW FACILITY AS WELL AS CONSTRUCTION OF NEW CULVERTS UNDER SIDEWALKS AND PARKING LOTS. THE PROPOSED STORM DRAINAGE IMPROVEMENTS WERE DESIGNED USING THE RATIONAL METHOD AND ARE IN ACCORDANCE WITH ALL U.S. STANDARDS FOR PIPE SIZING, SLOPES, AND MATERIAL. THE NEW STORM DRAINAGE PIPING WILL CONSIST OF CORRUGATED EXTERIOR HDPE PIPE WITH SMOOTH WALL INTERIOR OR REINFORCED CONCRETE PIPE.
  - WATER SUPPLY AND DISTRIBUTION**  
AS PART OF THE PROJECT, THE EXISTING FIRE HYDRANTS IN THE AREA ARE TO BE TESTED AND THE DATA PROVIDED TO AMERICAN WATER ENTERPRISE (AWE) TO CHECK AGAINST THEIR MODEL. AFTER DISCUSSION WITH AWE IT HAS BEEN DETERMINED THERE ARE NO CONNECTION POINTS OR FIRE HYDRANTS ON THE 12" WATER LINE AVAILABLE FOR FLOW TESTING. THIS WILL BE VERIFIED ONCE THE RE-ROUTE OF THE 12" LINE AND NEW FIRE HYDRANTS HAVE BEEN INSTALLED. NEW LATERAL SERVICE LINES WILL BE INSTALLED FROM THE EXISTING MAINS TO THE NEW BUILDING. THIS INFORMATION WILL BE VERIFIED WITH AWE AND UPDATED ACCORDINGLY. ALL OF THE FIRE HYDRANT FLOW DATA ESTIMATED DOMESTIC WATER DEMANDS, FIRE WATER DEMANDS FOR THE NEW FACILITY, AND WATER MODELING FROM A PREVIOUS PROJECT NOT CONSTRUCTED IN THE AREA ARE INCLUDED IN APPENDIX G OF THE RFP. MULTIPLE EXISTING WATER LINES WILL NEED TO BE REROUTED AS PART OF THIS PROJECT. THERE IS AN EXISTING 12" TRANSITE AND 24" CAST IRON WATER LINE RUNNING THRU THE FOOTPRINT OF THE NEW FACILITY. THE 12" LINE WILL BE REMOVED AND REROUTED AROUND THE SOUTH SIDE OF THE FACILITY. AN 8" LOOP WILL BE CONNECTED TO THIS LINE TO SERVE THE FACILITY WATER DEMANDS. THE EXISTING 24" CAST IRON WATER LINE IS ABANDONED. THIS LINE HAS BEEN PREVIOUSLY GROUT FILLED ACCORDING TO AWE. THE PORTION OF THIS LINE UNDER THE FOOTPRINT OF THE NEW FACILITY WILL BE REMOVED. AN EXISTING 24" WATER LINE UNDER THE NEW POV PARKING LOTS WILL ALSO NEED TO BE REMOVED. THIS LINE IS CURRENTLY TOO SHALLOW FOR THE LOADS OF THE NEW PARKING LOTS AND WILL NEED TO BE RELOCATED WITH A COVER DEPTH OF 42" (AWE'S STANDARD BURIAL COVER DEPTH).
  - SANITARY SEWER**  
THE ESTIMATED SEWER FLOWS FOR EACH OF THE PROPOSED BUILDINGS SHALL BE SENT TO AWE TO ANALYZE AGAINST THEIR MODEL TO DETERMINE IF THE DOWNSIDE SYSTEM HAS THE CAPACITY TO HANDLE THE ADDITIONAL FLOW. IT IS ANTICIPATED THE ADDITIONAL FLOWS FROM THE NEW FACILITIES DOES NOT EXCEED THE CAPACITY OF THE SYSTEM. THE NEW MAINS WILL BE 8" WITH THE NEW SERVICE LINES 6". THE NEW MAINS AND SERVICE LINES WILL HAVE PRE-CAST MANHOLES INSTALLED TO ALLOW FOR THE CONNECTION OF THE NEW FACILITY. ALL SEWER DISTRIBUTION DESIGN AND CONSTRUCTION WILL BE IN ACCORDANCE WITH AMERICAN WATER ENTERPRISE (AWE) STANDARDS AS THEY ARE. THE OWNER AND PERMIT HOLDER FOR THE SYSTEM. AWE WILL REVIEW THE PROPOSED DESIGN AT EACH SUBMITAL AND PROVIDE REVIEW COMMENTS. THE SANITARY SEWER WILL CONSIST OF PVC SDR 35 PIPE UNLESS CROSSING STREETS WHERE IT WILL BE SDR 21. PRECAST MANHOLES WILL BE UTILIZED WITH HS20 RATED FRAME AND COVERS IN ACCORDANCE WITH ASTM C478.
  - GAS SUPPLY AND DISTRIBUTION**  
ANY NEW GAS DISTRIBUTION PIPING WILL BE INSTALLED AT NO COST TO THE CONTRACTOR BY ONG WITH ANY RELOCATION COSTS OR NEW CONSTRUCTION COSTS REIMBURSED BY THE GOVERNMENT TO ONG. ONG WILL REVIEW THE DESIGN DOCUMENTS TO VERIFY THAT THE LAYOUT INDICATED IS IN LINE WITH THEIR REQUIREMENTS AND THE FUNCTION OF THE ENTIRE SYSTEM FOR FT. SILL.
  - LANDSCAPING**  
THERE ARE NO KNOWN IRRIGATION SYSTEMS IN THE AREA OF THE NEW PROJECT WORK AND THERE IS NO REQUIREMENT FOR NEW IRRIGATION AROUND THE PARKING LOTS OR ROAD IMPROVEMENTS. THERE WILL BE SOME EXTERIOR HOSE BIBS ON THE FACILITY TO ALLOW FOR WATERING OF LOW GROWTH PLANTINGS ADJACENT TO THE BUILDING. EXISTING LANDSCAPED AREAS WILL BE MAINTAINED TO THE MAXIMUM EXTENT POSSIBLE, BUT SOME TREES, SHRUBS, ETC. WILL BE REMOVED TO ALLOW FOR THE GRADING AND DRAINAGE IMPROVEMENTS TO THE AREA. REPLACEMENT TREES, SHRUBS, TURF AND VEGETATION WILL BE SELECTED BASED ON NATIVE SPECIES, WHICH ARE DROUGHT RESISTANT AND MATCH THE THEME FOR THE AREA. THE EXTENT OF NEW LANDSCAPING WILL DEPEND ON PROJECT FUNDING.




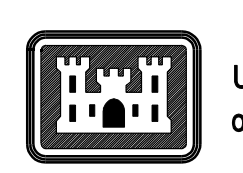
GENERAL CONSTRUCTION NOTES

- THE LOCATIONS OF UNDERGROUND UTILITIES AS INDICATED ON THE PLANS HAVE BEEN OBTAINED FROM EXISTING RECORDS AND FIELD SURVEYS. THE GOVERNMENT DOES NOT ASSUME ANY RESPONSIBILITY WITH RESPECT TO THE ACCURACY, COMPLETENESS, OR SUFFICIENCY OF THE INFORMATION. THERE IS NO GUARANTEE, EITHER EXPRESSED OR IMPLIED, THAT THE LOCATIONS, SIZE AND TYPE OF MATERIAL OF EXISTING UNDERGROUND UTILITIES INDICATED ARE REPRESENTATIVE OF THOSE TO BE ENCOUNTERED IN THE CONSTRUCTION.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE ACTUAL LOCATION OF ALL SUCH UTILITIES, INCLUDING DUCT BANKS, CONDUITS, CABLING, AND SERVICE CONNECTIONS TO UNDERGROUND UTILITIES AND TAKE PRECAUTIONS TO AVOID DAMAGE DURING DEMOLITION AND CONSTRUCTION.
- PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE CONTRACTING OFFICER OF OPERATIONAL PLANS. IN THE EVENT AN UNEXPECTED UTILITY INTERFERENCE IS ENCOUNTERED DURING CONSTRUCTION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CONTRACTING OFFICER. ANY SUCH MAINS AND/OR SERVICES DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED IMMEDIATELY AT CONTRACTOR'S EXPENSE TO THE SATISFACTION OF THE GOVERNMENT.
- THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING SIGNAGE, LIGHTING, AND UTILITIES TO REMAIN FROM DAMAGE DURING CONSTRUCTION. IF DAMAGED, CONTRACTOR SHALL REPAIR OR REPLACE SIGNAGE, LIGHTING, AND UTILITIES TO THE SATISFACTION OF AND AT NO EXPENSE TO THE GOVERNMENT.
- ALL UTILITIES BEING REMOVED SHALL BE CAPPED AND PLUGGED AT THE LIMITS OF REMOVAL.
- THE CONTRACTOR SHALL NOTIFY THE CONTRACTING OFFICER IMMEDIATELY UPON ANY UTILITY CONFLICT.
- ALL SUBSURFACE UTILITY LINES, NEW AND OLD, SHOULD BE LOCATED AND MARKED. IF ASBESTOS CONTAINING MATERIAL (ACM) IS PRESENT (ON SUBSURFACED UNDERGROUND PIPING, ETC.) AND REQUIRES REMOVAL, IT SHOULD BE PERFORMED BY AN INDIVIDUAL OR FIRM TRAINED IN ASBESTOS ABATEMENT AND LICENSED WITH THE STATE OF OKLAHOMA. QUESTIONS SHALL BE DIRECTED TO THE CONTRACTING OFFICER AND TO DAREK QUICKLE OR GARY JARNAGIN WITH THE ENVIRONMENTAL QUALITY DEPARTMENT (EQD) AT 580-442-5671 AND THE CONTRACTING OFFICER SHALL BE NOTIFIED.
- CONTRACTOR SHALL PLACE ALL SEDIMENT CONTROL DEVICE(S) AS SHOWN ON EROSION CONTROL DRAWINGS PRIOR TO BEGINNING WORK AND SHALL REMAIN IN PLACE UNTIL THE PROJECT IS COMPLETE.
- IF, DURING ANY PHASE OF CONSTRUCTION, THERE ARE ANY ARTIFACTS (E.G., ARROWHEADS, BONES, BUILDING OR STRUCTURAL REMAINS, PRE 1940'S REFUSE, ETC.) UNCOVERED, THEN ALL WORK SHALL STOP AND THE CONTRACTOR SHALL CONTACT THE CONTRACTING OFFICER WHO SHOULD CONTACT KEVIN CHRISTOPHER, ENVIRONMENTAL QUALITY DEPARTMENT (EQD) AT 580-442-2256.
- SEE DRAWING G002 FOR STAGING AND LAYDOWN AREAS. ROADS ARE TROOP AND PT MARCHING ROUTES. NO PARKING OF VEHICLES, EQUIPMENT, OR MATERIALS ON ANY ROAD OR PARKING AREA NOT DESIGNATED AS CONTRACTOR STAGING OR LAYDOWN AREA WILL BE PERMITTED.
- CONTRACTOR AND CONTRACTING OFFICER SHALL COORDINATE SITE CONDITION INVESTIGATION OF PARKING LOTS, ROADS, ETC. AT EACH PHASE OF CONSTRUCTION TO DOCUMENT ANY DAMAGE TO EXISTING PAVEMENTS, ETC. AND DETERMINE NEEDED REPAIRS PRIOR TO TURN OVER TO THE GOVERNMENT.

KEYED NOTES

- CONTRACTORS SHALL KEEP ALL PUBLIC ROADS AND STREETS CLEAN OF CONSTRUCTION DEBRIS, MUD, ETC. AT ALL TIMES. CONTRACTOR TO PROVIDE EQUIPMENT AND PERSONNEL TO CLEAN ANY STREETS AS REQUESTED BY CONTRACTING OFFICER. CONTRACTOR IS RESPONSIBLE FOR ALL REPAIRS TO STREETS, PARKING AREAS, ETC. DUE TO DAMAGE BY THEIR CONSTRUCTION ACTIVITIES.
- FT. SILL BLVD. ACCESS GATE TO BE USED FOR ALL CONSTRUCTION VEHICLES, DELIVERIES, ETC. FT. SILL SECURITY TO CONTROL ACCESS.
- FOR PROJECT LIMITS, SEE SHEET G001.

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL   | DESCRIPTION                            | DATE                     | APPR                         |
|--|--|--------------------------|------------------------------|
| <div><div><div>51121</div></div><div><div>US Army Corps of Engineers</div></div></div> |  |                          |                              |
| DESIGNED BY:<br><b>A. MASHEK</b>   | FORT SILL ARMY POST<br>OKLAHOMA        |                          |                              |
| DRAWN BY:<br><b>B. LEIKER</b>  | PDC: 65299                             |                          | FY: 10                       |
| REVIEWED BY:<br><b>R. BARUTH</b>   | CENTRAL ISSUE FACILITY<br>(CIF)        |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC.   | OVERALL PROJECT<br>CONSTRUCTION ACCESS |                          |                              |
| PLOT SCALE:<br><b>AS SHOWN</b>   | DWG. CODE:                             | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br><b>FS10CFG-000.DGN</b>   |  | RFP NO.<br>W9126V--      | <b>G000</b>                  |
| PLOT DATE:<br><b>XX-XXX-2009</b>   | SHEET<br><b>3</b> OF<br><b>41</b>      | CONTRACT NO.<br>W9126V-- |                              |



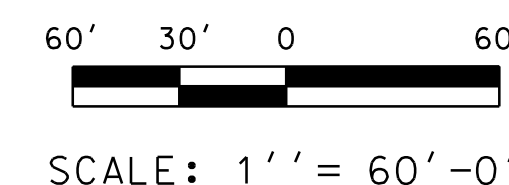





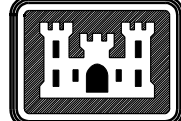


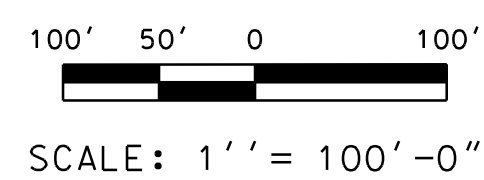
NOTES:

1. CONTRACTOR SHALL INSTALL TEMPORARY TRAFFIC BARRIERS TO CLOSE ROADS TO A NON-CONSTRUCTION TRAFFIC. COORDINATE WITH FT. SILL POLICE. SEE DETAIL ON G001
2. CONTRACTOR TO STOCKPILE MATERIALS WITHIN PROJECT LIMITS.
3. IF CONTRACTOR INSTALLS TEMPORARY CONSTRUCTION FENCE AROUND THE LIMITS OF SITE WORK, COORDINATE CHASE AND PADLOCKS ON THE GATES WITH FT. SILL FIRE DEPT. EACH GATE TO BE NUMBERED FOR EMERGENCY ACCESS.
4. CONTRACTOR TO MAINTAIN FIRE ACCESS THROUGH THE CONSTRUCTION SITE.
5. ALL SOLID WASTE, DEMOLITION, CONSTRUCTION DEBRIS, SHALL BE DELIVERED TO THE PORT SILL SANITARY LANDFILL IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS AS WELL AS PORT SILL LANDFILL REQUIREMENTS. COMMENTS: THE CONTRACTOR SHALL AT NO COST AS LONG AS THEY PARTICIPATE IN PORT SILL'S CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PROGRAM, WHICH INCLUDES, BUT NOT LIMITED TO CREATING A WASTE MANAGEMENT PLAN AND REPORTING WASTE REUSE AND RECYCLE QUANTITIES EACH MONTH. SEE ADDITIONAL REQUIREMENTS IN THE PROJECT SPECIFICATIONS. SEE DRAWING 3000 FOR LOCATION OF THE LANDFILL.
6. FT. SILL ROADS ARE TROOP AND PHYSICAL TRAINING (PT) MARCHING AREAS. IF PARKING OR VEHICLE STAGING OF SUPPLY MATERIALS ON ANY ROAD OR PARKING AREA NOT DESIGNATED AS CONTRACTOR STAGING OR LAYDOWN AREA WILL BE PERMITTED.
7. IF, DURING ANY PHASE OF CONSTRUCTION, THERE ARE ANY ARTIFACTS (e.g., ARROWHEADS, BONES, BUILDING OR STRUCTURAL REMAINS, PRE 1940'S REFUSE, ETC.) UNCOVERED WHILE DOING ALL WORK SHALL BE STOPPED IMMEDIATELY. SHALL CONTACT THE CONTRACTING OFFICER WHO SHOULD CONTACT KEVIN CHRISTOPHER, ENVIRONMENTAL QUALITY DEPARTMENT (EQD) AT 580-442-2255.
8. THE CONTRACTOR SHALL NOTIFY THE CONTRACTING OFFICER PRIOR TO FACING HOLES, OR FENCING OR DOING ANY OTHER TYPE OF CONSTRUCTION THAT COULD AFFECT CULTURAL RESOURCES OVERSIGHT CAN BE SCHEDULED AND COORDINATED.
9. CONTRACTOR AND CONTRACTING OFFICER, SHALL COORDINATE SITE CONDITION OF PARKING LOTS, ROADS, ETC. AT EACH PHASE OF CONSTRUCTION TO DOCUMENT ANY DAMAGE TO EXISTING PARKING LOTS, ETC. AND ANY NEEDED REPAIRS PRIOR TO TURN OVER TO THE GOVERNMENT.




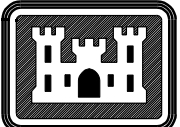
USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

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| SUBMITTER'S<br>SYMBOL  | DESCRIPTION            |  |             | DATE                         | APPROVED BY |
| <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;">  <p>21121</p> </div> <div style="width: 48%; text-align: center;">  <p>US Army Corps<br/>of Engineers</p> </div> </div> |                        |  |             |                              |             |
| DESIGNED BY:<br><b>A. MASHEK</b>   |                        | FORT SILL ARMY POST<br>OKLAHOMA<br><br>PDC: 65299<br><br>CENTRAL ISSUE FACILITY<br>(CIF) |             |                              |             |
| DRAWN BY:<br><b>B. LEIKER</b>  |                        |  |             |                              |             |
| REVIEWED BY:<br><b>R. BARUTH</b>   |                        |  |             |                              |             |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC.   |                        | STAGING AND LAYDOWN AREA   |             |                              |             |
|  |                        |  |             |                              |             |
| PLOT SCALE:<br><b>AS SHOWN</b>   | DWG. CODE:             | CONTRACT DATE:   |             | SHEET<br>REFERENCE<br>NUMBER |             |
| DESIGN FILE:<br><b>FS10CFG-002.DGN</b>   | RFP NO.<br>WB12BV--    |  | <b>G002</b> |                              |             |
| PLOT DATE:<br>10Y, 10M, 2000   | SHEET    5    OF    41 |  |             |                              |             |
|  |                        | CONTRACT NO.<br>WB12BV--   |             |                              |             |



**FOR REFERENCE ONLY**

1. CONTRACTOR SHALL KEEP ALL PUBLIC ROADS AND STREETS CLEAN OF CONSTRUCTION DEBRIS, MUD, ETC. AT ALL TIMES. CONTRACTOR TO PROVIDE EQUIPMENT AND PERSONNEL TO CLEAN ANY STREETS AS REQUESTED BY THE CONTRACTING OFFICER. CONTRACTOR IS RESPONSIBLE FOR ALL REPAIRS TO STREETS, PARKING AREAS, ETC. DUE TO DAMAGE BY THIS CONSTRUCTION ACTIVITIES. SEE SHEET G001.
2. FT. SILL BLVD. ACCESS GATE TO BE USED FOR ALL CONSTRUCTION VEHICLES, DELIVERIES, ETC. FT. SILL SECURITY TO CONTROL ACCESS.

| USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"                              |  |   |                              |
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| SYMBOL  | DESCRIPTION  | DATE  | APPR                         |
|      |  |  US Army Corps<br>of Engineers |                              |
| 51121   |  |   |                              |
| DESIGNED BY:<br><b>A. MASHEK</b>  | FORT SILL ARMY POST<br>OKLAHOMA<br><br>PDC: 65299 FY: 10<br><br>CENTRAL ISSUE FACILITY<br>(CIF)<br><br><b>CONSTRUCTION GATE<br/>ENLARGEMENT PLAN</b> |   |                              |
| DRAWN BY:<br><b>B. LEIKER</b>   |  |   |                              |
| REVIEWED BY:<br><b>R. BARUTH</b>  |  |   |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC |  |   |                              |
| PLOT SCALE:<br><b>AS SHOWN</b>  | DWG. CODE:   | CONTRACT DATE:  | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE: <b>FS10CFG-003.DGN</b>   |  | RFP NO.<br>W812BV—  | <b>G003</b>                  |
| PLOT DATE:<br>XX - XXX - 2009   | SHEET <b>6</b> OF <b>41</b>  | CONTRACT NO.<br>W812BV—   |                              |
| Friday, February 18, 2011   |  |   |                              |







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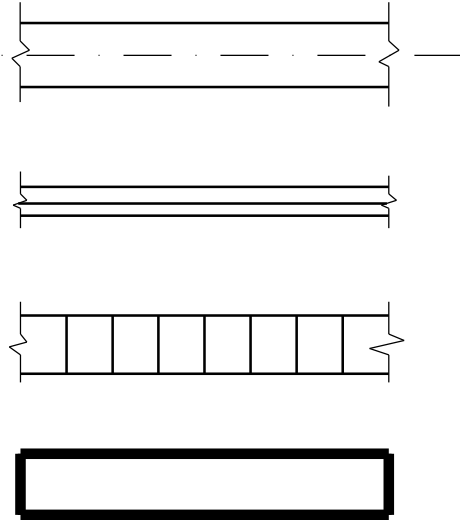
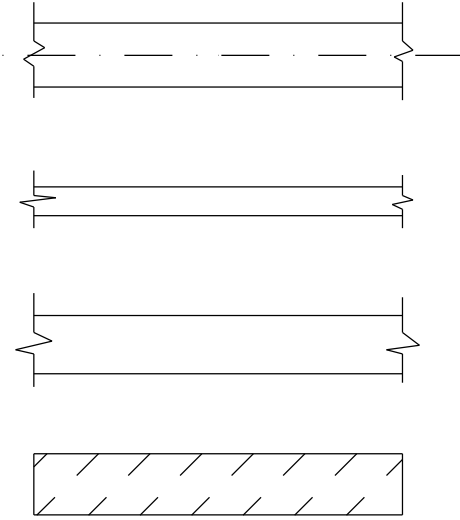
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LEGEND

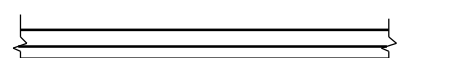
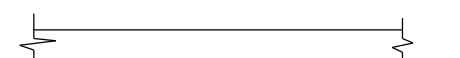
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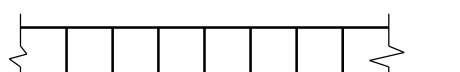
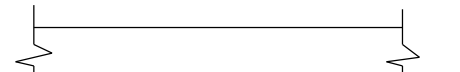
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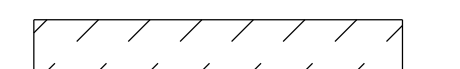
ROADS AND PAVED AREAS



CURB AND GUTTER



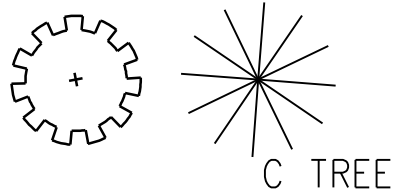
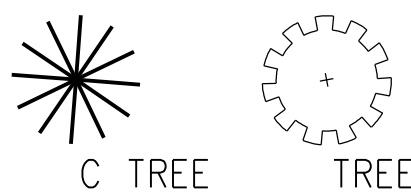
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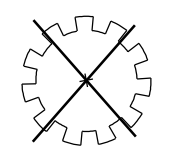
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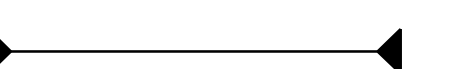
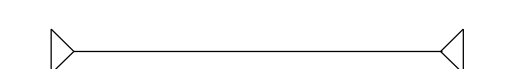
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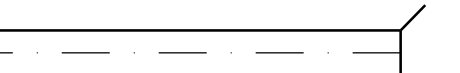
TREES AND SHRUBS



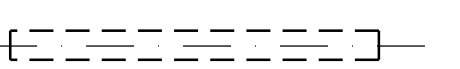
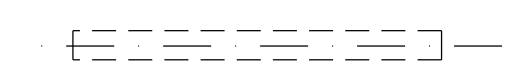
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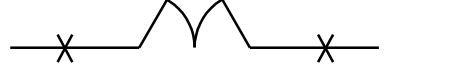
CULVERT WITH END SECTIONS



CULVERT WITH END WALL(S)



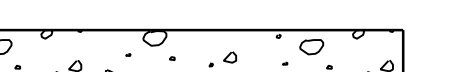
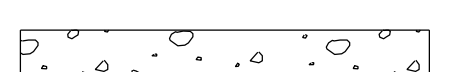
CASING PIPE



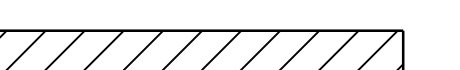
GATE-SHOWING  
DIRECTION OF SWING



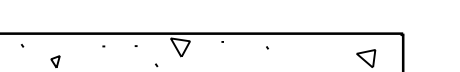
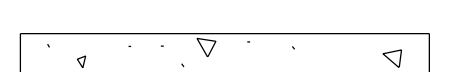
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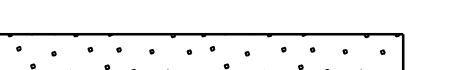
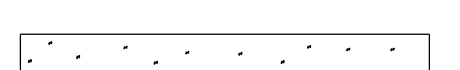
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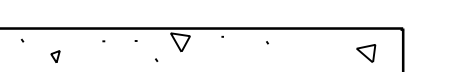
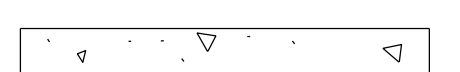
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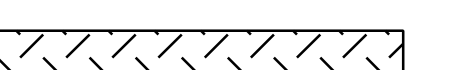
CONCRETE (SECTION)



ASPHALT (PLAN)



CONCRETE (PLAN)



ASPHALT OVERLAY



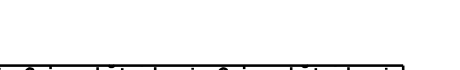
ASPHALT PAVEMENT  
REMOVAL/DEMOLITION/MILLING



UTILITY REMOVAL



FENCE DEMOLITION



TEMPORARY CONSTRUCTION ROAD

LEGEND

EXISTING

NEW

DESCRIPTION



DIRECTION OF TRAVEL



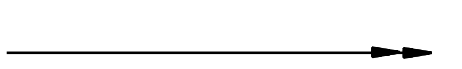
MATCH LINE



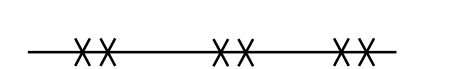
CENTERLINE



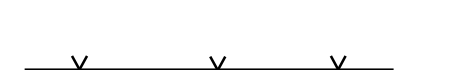
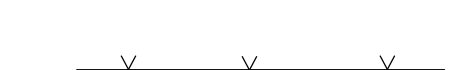
CONTRACTORS TEMPORARY BARRICADES



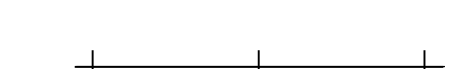
DIMENSION LINE EXTENSION  
BEYOND MATCH LINE OR  
EDGE OF DRAWING



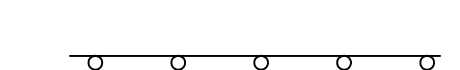
TEMPORARY CONSTRUCTION FENCE



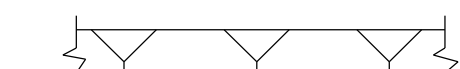
SECURITY FENCE



RAILROAD



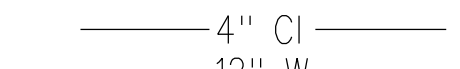
GUARDRAIL



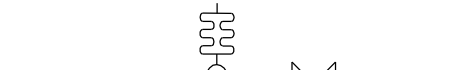
SLOPE INDICATOR



FLOW LINE



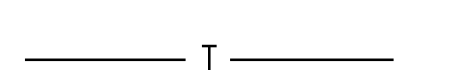
WATER LINE



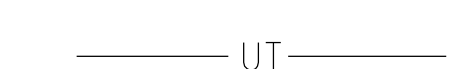
VALVE & VALVE BOX



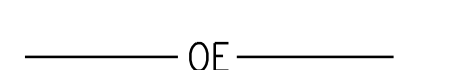
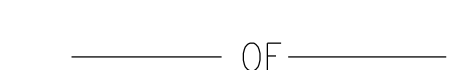
POST INDICATOR VALVE



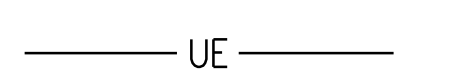
OVERHEAD TELEPHONE LINE



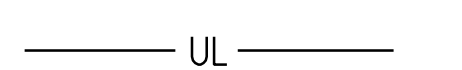
UNDERGROUND TELEPHONE LINE



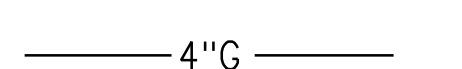
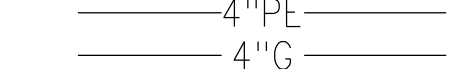
OVERHEAD ELECTRIC LINE



UNDERGROUND ELECTRIC LINE



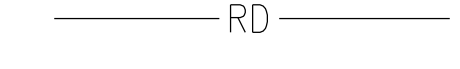
UNDERGROUND STREET LIGHTING CIRCUIT



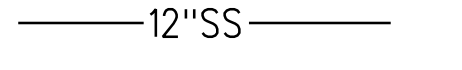
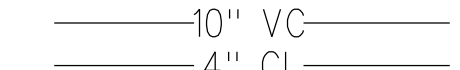
GAS LINE



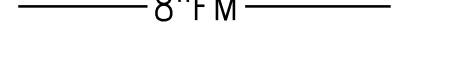
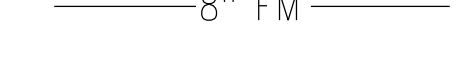
REINFORCED CONCRETE PIPE



ROOF DRAIN



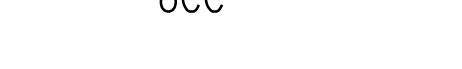
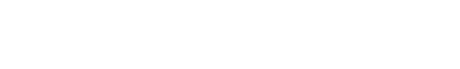
SANITARY SEWER



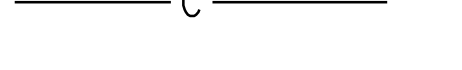
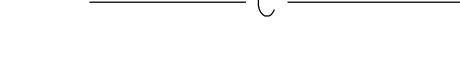
FORCE MAIN



STORM SEWER



UNDERGROUND COMMUNICATION CONDUIT



COMMUNICATION LINE



UNDERGROUND COMMUNICATION LINE



DRAINAGE DITCH

LEGEND

EXISTING

NEW

DESCRIPTION



MAJOR CONTOUR (1.00')



FINISH GRADE ELEVATION (PLAN)



VERTICAL CONTROL POINT  
(TEMPORARY BENCH MARK)



VERTICAL CONTROL POINT (BENCH MARK)



VERTICAL CONTROL POINT  
(USGS BENCH MARK)



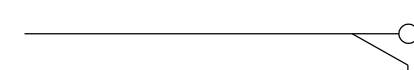
BORING LOCATION



CLEAN OUT



STORM MANHOLE



SANITARY  
SEWER MANHOLE



DROP INLET



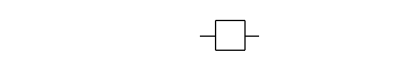
INLET



FIRE HYDRANT



RESTRAINED JOINT



WATER METER



GAS METER



LIFT STATION



UTILITY POLE



STREET LIGHT



GUY & ANCHOR



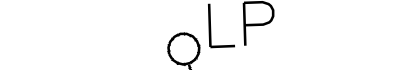
SIGN



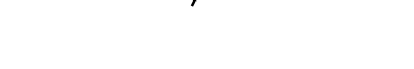
TRAFFIC CONTROL SIGNS



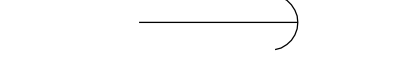
ELECTRICAL MANHOLE



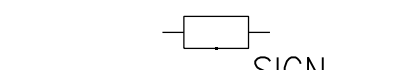
TRANSFORMER



COMMUNICATIONS MANHOLE



REDUCER



CAP, PLUG, BLIND FLANGE



SANITARY SEWER  
CLEANOUT



CATHODIC PROTECTION  
TEST STATION



ROOF DRAIN DOWNSPOUT

ABBREVIATIONS

|          |  |
|----------|--|
| AC-      | ACRE   |
| ACM-     | ASBESTOS CONTAINING MATERIAL                 |
| ATFP-    | ANTI-TERRORISM/FORCE PROTECTION              |
| AWE-     | AMERICAN WATER ENTERPRISES                   |
| B/C-     | BOTTOM OF CURB                               |
| BDE-     | BRIGADE                                      |
| C-C-     | CENTER TO CENTER                             |
| COE      | CORPS OF ENGINEERS                           |
| CONC.-   | CONCRETE                                     |
| CPNODE-  | CATHODIC PROTECTION SYSTEM NODE              |
| CGMP-    | CORRUGATED GALVANIZED METAL PIPE             |
| CGMPA-   | CORRUGATED GALVANIZED METAL PIPE ARCH        |
| CI-      | CURB INLET OR CAST IRON PIPE                 |
| CTREE-   | CONFIRE TREE                                 |
| CU-      | COPPER                                       |
| D/B      | DESIGN BUILD                                 |
| DFAC-    | DINING FACILITY                              |
| DI-      | DUCTILE IRON OR DROP INLET                   |
| DIA-     | DIAMETER                                     |
| D.N.D.-  | DO NOT DISTURB                               |
| DSP-     | DOWNSPOUT                                    |
| DWG-     | DRAWING                                      |
| EQD-     | ENVIRONMENTAL QUALITY DEPARTMENT             |
| EL/ELEV- | ELEVATION                                    |
| FDC-     | FIRE DEPARTMENT CONNECTION                   |
| FF-      | FINISH FLOOR                                 |
| FH-      | FIRE HYDRANT                                 |
| FL-      | FLOW LINE                                    |
| FNC-     | FENCE  |
| FT.-     | FORT   |
| FT-      | FOOT   |
| FW-      | FIREWATER                                    |
| HDPE-    | HIGH DENSITY POLYETHYLENE                    |
| HQ-      | HEADQUARTERS                                 |
| MAX-     | MAXIMUM                                      |
| MH-      | MANHOLE                                      |
| MIN-     | MINIMUM                                      |
| MUTCD-   | MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES    |
| NO.-     | NUMBER                                       |
| OC-      | ON CENTER                                    |
| ODEQ-    | OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY |
| ONG-     | OKLAHOMA NATURAL GAS                         |
| OSHA-    | OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION  |
| PCC-     | PORTLAND CEMENT CONCRETE                     |
| PE-      | POLYETHYLENE                                 |
| POV-     | PRIVATELY OWNED VEHICLE                      |
| PT-      | PHYSICAL TRAINING                            |
| PUG-     | POWER UNDERGROUND                            |
| PVC-     | POLYVINYL CHLORIDE                           |
| RCB-     | REINFORCED CONCRETE BOX                      |
| RCP-     | REINFORCED CONCRETE PIPE                     |
| RFDC-    | REMOTE FIRE DEPARTMENT CONNECTION            |
| RFP-     | REQUEST FOR PROPOSAL                         |
| RMA-     | RESIN MODIFIED ASPHALT                       |
| SFAC-    | SOLDIER FAMILY ASSISTANCE CENTER             |
| SSMH-    | SANITARY SEWER MANHOLE                       |
| ST,SD-   | STORM SEWER, STORM DRAIN, STREET             |
| SWPPP-   | STORM WATER POLLUTION PREVENTION PLAN        |
| TC-      | TERRA COTTA                                  |
| T/C -    | TOP OF CURB                                  |
| (TYP)-   | TYPICAL                                      |
| UEPH-    | UNACCOMPANIED ENLISTED PERSONNEL HOUSING     |
| VC-      | VITRIFIED CLAY                               |
| WTU-     | WARRIOR TRANSITION UNIT                      |
| WV-      | WATER VALVE                                  |

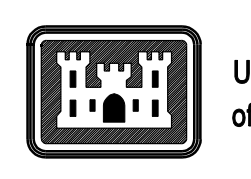
USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

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51121



US Army Corps  
of Engineers

DESIGNED BY:

A. MASHEK

DRAWN BY:

B. LEIKER

REVIEWED BY:

R. BARUTH

SUBMITTED BY:

CHARLES LOUDON

PROJECT MANAGER

BURNS & MCDONNELL

ENGINEERS, INC.

FORT SILL ARMY POST

OKLAHOMA

PDC: 65299

FY: 10

CENTRAL ISSUE FACILITY

(CIF)

LEGEND AND ABBREVIATIONS

PLOT SCALE:

AS SHOWN

DWG. CODE:

CONTRACT DATE:

SHEET

DESIGN FILE:

FS10CFG-008.DGN

RFP NO.

W9126V-

PLOT DATE:

XX - XXX - 2009

SHEET

9 OF

41

CONTRACT NO.

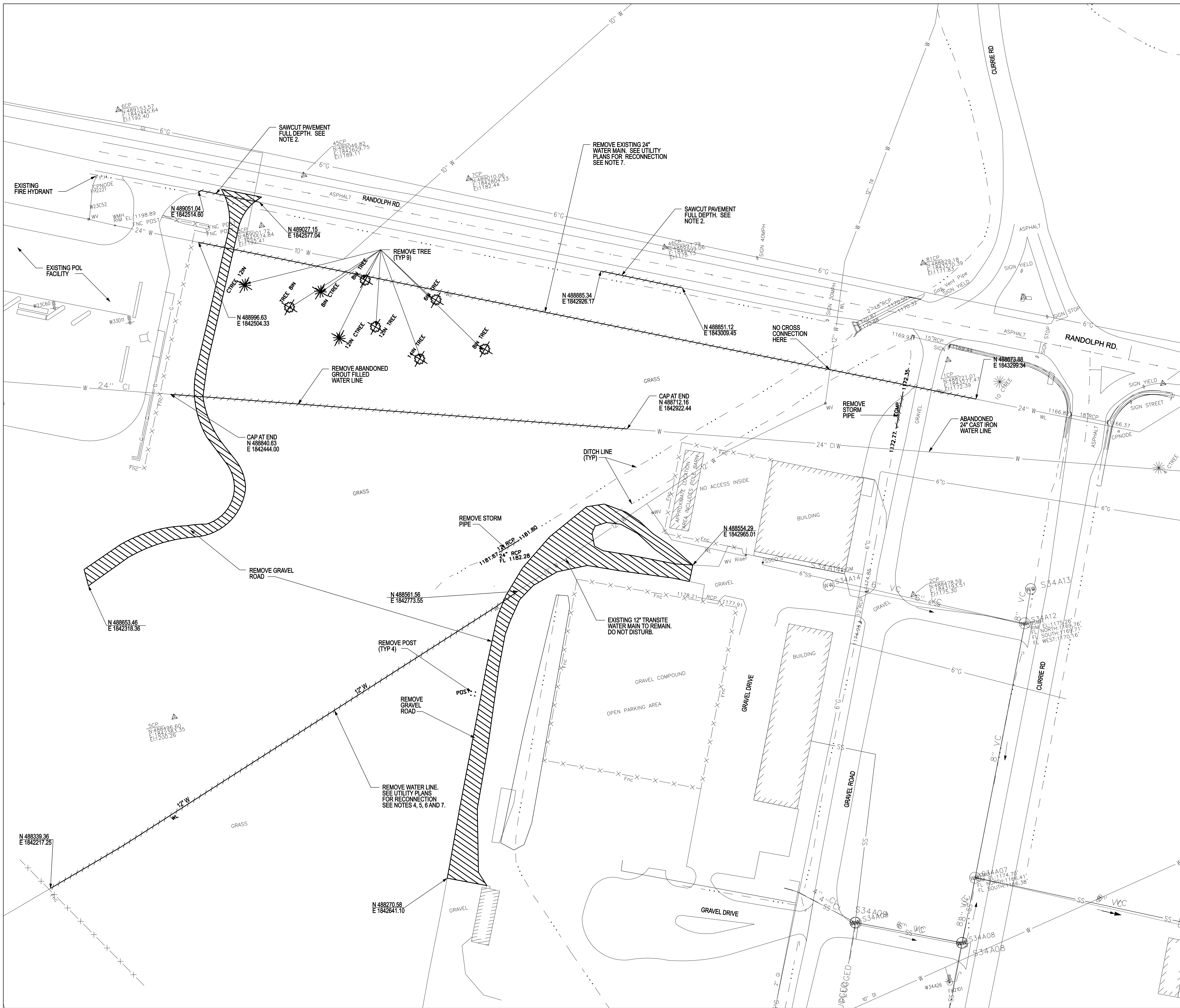
W9126V-

G006

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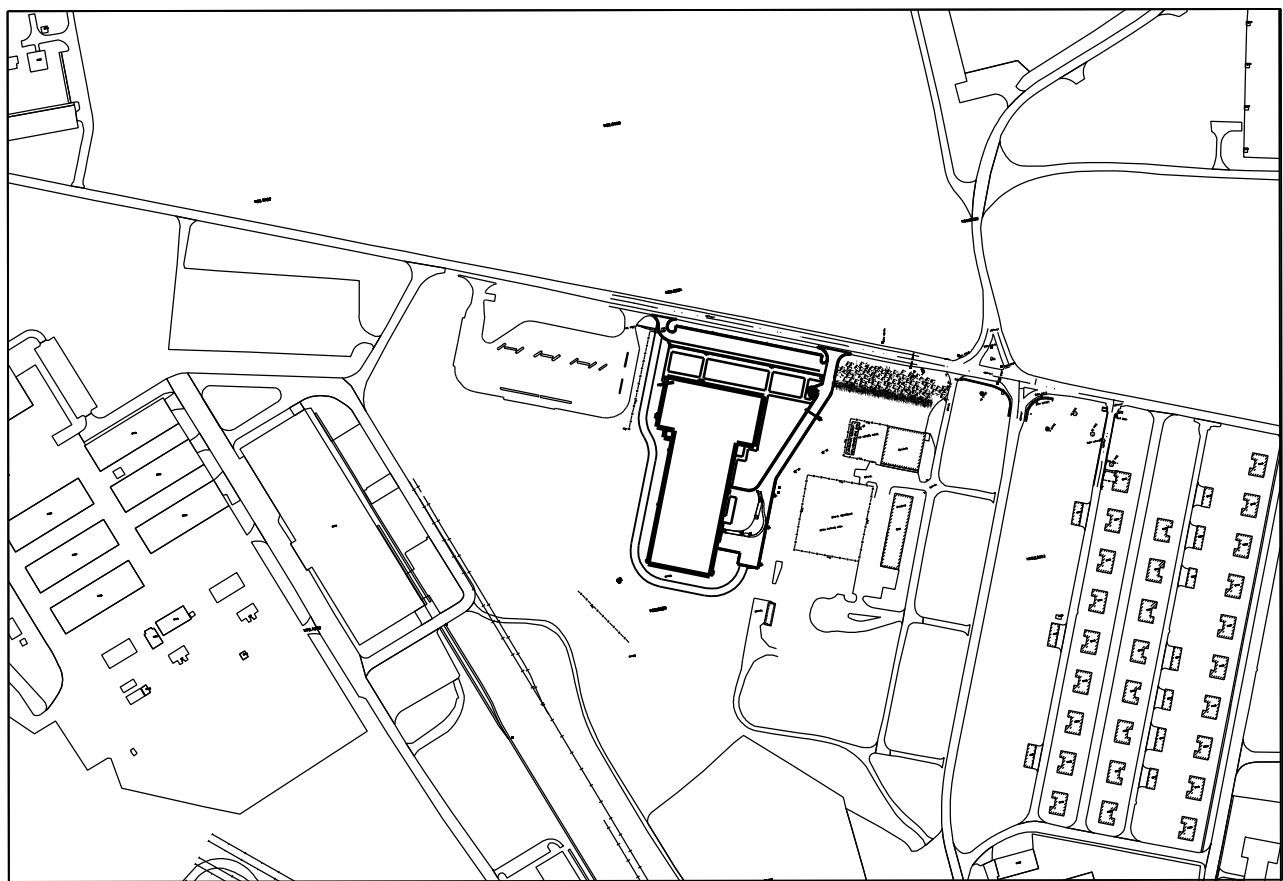
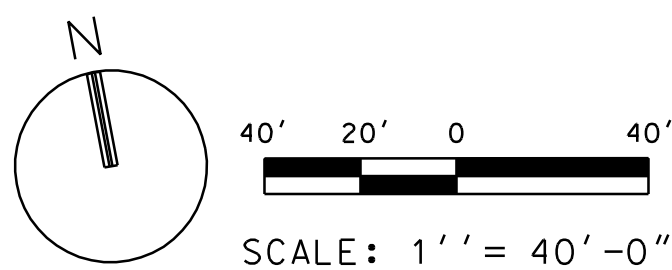
Friday, February 18, 2011





DEMOLITION NOTES:



1. SEE GENERAL PROJECT SCOPE NOTES ON G000.
2. SAWCUT PAVEMENT AND REMOVE 2.00' STRIP TO PROVIDE CLEAN EDGE FOR CONSTRUCTION OF NEW PAVEMENT. SEE DETAIL A C500.
3. SEE ELECTRICAL SHEETS FOR ELECTRICAL AND COMMUNICATION UTILITY DEMOLITION.
4. FRIABLE ASBESTOS MATERIAL SHALL NOT BE INTRODUCED TO THE WATER DISTRIBUTION SYSTEM. ASBESTOS CONCRETE (TR) PIPE SHALL NOT BE CUT, BROKEN, SAWED, DRILLED OR OTHERWISE CAUSED TO INTRODUCE FRIABLE ASBESTOS MATTER INTO THE WATER DISTRIBUTION SYSTEM. TAPS & CONNECTIONS SHALL BE MADE BY MOVING BOTH UPSTREAM AND DOWNSTREAM TO THE NEAREST TR COLLAR ON THE EXISTING PIPE. THE TR COLLAR SHALL BE REMOVED FROM AROUND THE EXISTING PIPE, BY A QUALIFIED PERSON, IN SUCH MANNER AS TO REDUCE THE FRIABLE MATTER AND DISPOSED OF ACCORDING TO LOCAL REGULATIONS. THE EXISTING PIPE SEGMENT(S) IN THE AREA OF THE CONNECTION SHALL BE WHOLLY REMOVED AND DISPOSED OF BY LOCAL REGULATIONS FOR DISPOSING OF NON-FRIABLE ASBESTOS MATERIAL. THE NEW CONNECTION(S) SHALL BE MADE TO THE EXISTING END(S) OF THE EXPOSED PIPE. ADDING NEW NON-ASBESTOS WATER PIPE AS REQUIRED. TO REPLACE THIS SECTION(S) OF EXISTING PIPE THAT WAS REMOVED. WORK SHALL BE COORDINATED WITH AWE, CONTRACTING OFFICER, AND ODEO.
5. ALL SUBSURFACE UTILITY LINES, NEW AND OLD, SHALL BE LOCATED AND MARKED. IF ASBESTOS CONTAINING MATERIAL (ACM) IS PRESENT AND REQUIRES REMOVAL, IT SHOULD BE PERFORMED BY AN INDIVIDUAL OR TEAM TRAINED IN ASBESTOS ABATEMENT AND LICENSED WITH THE STATE OF OKLAHOMA.
6. THE EXISTING 12" TRANSITE (ASBESTOS CONCRETE) WATER MAIN LINE IS THE SINGLE EXISTING SOURCE OF WATER AND FIRE PROTECTION TO THE 1200 & 1400 AREAS OF FT SILL. INTERRUPTION OF THE SERVICE TO THESE AREAS MUST BE COORDINATED WITH AWE, FT SILL FIRE DEPARTMENT, AND THE CONTRACTING OFFICER PRIOR TO CONSTRUCTION.
7. COORDINATE WORK WITH AWE, FT SILL FIRE DEPARTMENT, AND CONTRACTOR OFFICER BEFORE BEGINNING CONSTRUCTION. FINAL CONNECTION/DISCONNECTION WORK SHALL OCCUR OVER A WEEKEND TO LIMIT THE DISRUPTION IN SERVICE.



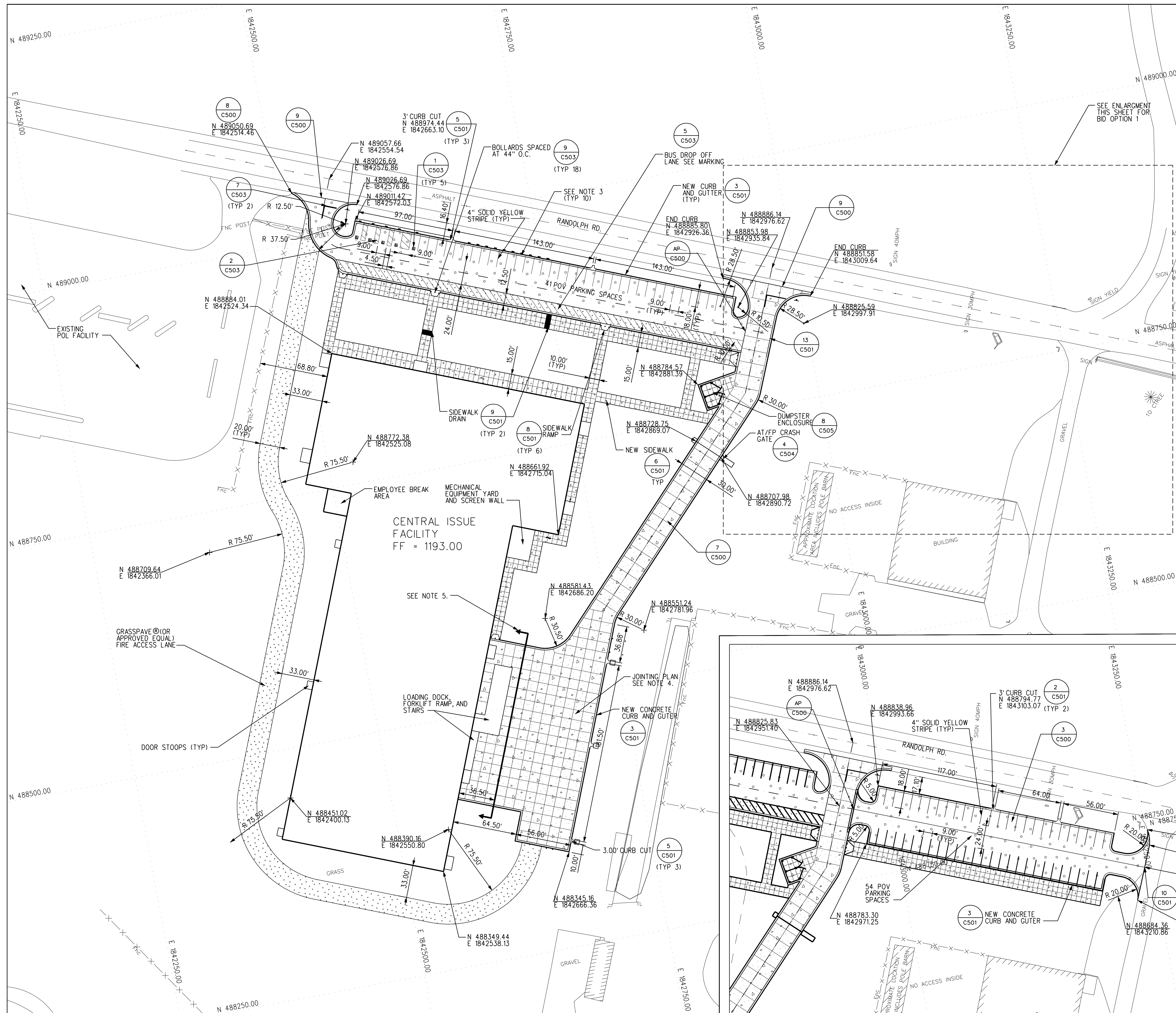
KEY PLAN  
N.T.S.

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

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| SYMBOL   |  | DESCRIPTION  |                                 | DATE                         | APPRO  |
| <div><br/>51121</div> |  | <div>US Army Corps<br/>of Engineers</div> |                                 |                              |        |
| DESIGNED BY:<br>A. MASHEK  |  | PDC: 65299   | FORT SILL ARMY POST<br>OKLAHOMA |                              | FY: 10 |
| DRAWN BY:<br>B. LEIKER   |  |  | CENTRAL ISSUE FACILITY<br>(CIF) |                              |        |
| REVIEWED BY:<br>R. BARUTH  |  |  |                                 |                              |        |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC                  |  |  | DEMOLITION PLAN                 |                              |        |
| PLOT SCALE:<br>AS SHOWN  |  | DWG. CODE:   | CONTRACT DATE:                  | SHEET<br>REFERENCE<br>NUMBER |        |
| DESIGN FILE:<br>FS10CFC-100.DGN  |  |  | RFP NO.<br>W812BV—              |                              |        |
| PLOT DATE:<br>XX - XXX - 2009  |  | SHEET<br>10 OF<br>41   | CONTRACT NO.<br>W812BV—         | C100                         |        |

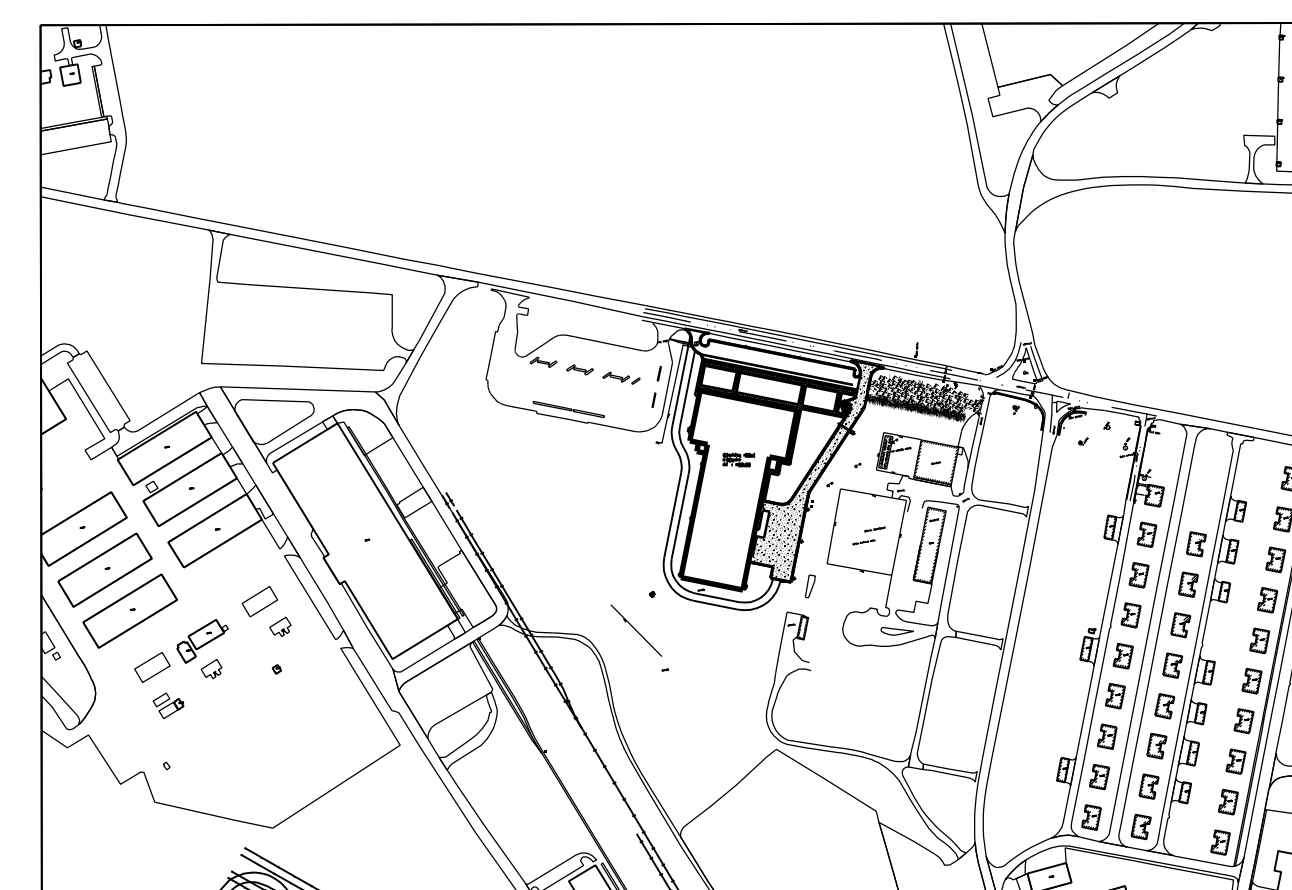
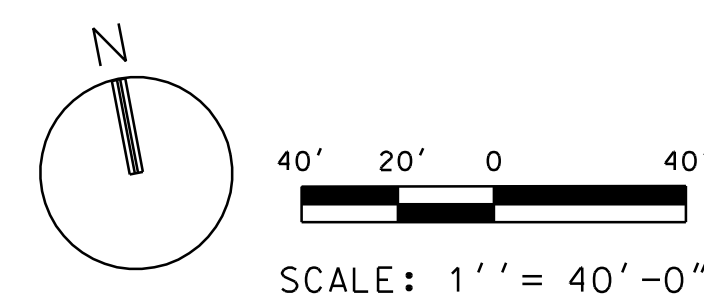




- NOTES:
- SEE PROJECT SCOPE NOTES ON G000.
  - DIMENSIONS, RADIUS CALLOUTS, AND COORDINATES ARE TO CENTERLINE OF ROAD, BACK OF CURB, AND OUTSIDE CORNER OF BUILDING UNLESS INDICATED OTHERWISE.
  - RESERVED PARKING SPACE FOR "LOW EMISSION/FUEL EFFICIENT VEHICLES ONLY" SIGN. ALTERNATE WITH "CARPOOL VEHICLE ONLY" SIGN. TYPICAL 5 EACH. SEE DETAILS 11 AND 12 SHEET C501.
  - SEE SHEETS C400 AND C401 FOR PAVEMENT JOINTING AND ELEVATION PLANS.
  - CONTRACTOR SHALL DESIGN AND CONSTRUCT ALL SITE PAVEMENT. FINAL DESIGN OF THE PAVEMENT BETWEEN THE BUILDING AND THE DEMARCATION LINE SHALL BE BASED ON THE LOADING DOCK AND FORKLIFT RAMP LOCATIONS. ALL PAVEMENT DESIGN SHALL BE APPROVED BY THE CO PRIOR TO CONSTRUCTION.

LEGEND

|  |                                |    |      |
|--|--------------------------------|----|------|
|  | 8" CONCRETE                    | 4  | C500 |
|  | 5.5" ASPHALT (POV PARKING)     | 2  | C500 |
|  | 6" ASPHALT (BUS DROP OFF LANE) | 3  | C500 |
|  | 6" GRAVEL                      | 1  | C500 |
|  | GRASS@ PAVE                    | 11 | C500 |
|  | 4" CONCRETE                    | 6  | C501 |



KEY PLAN  
N.T.S.

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DESIGNED BY:  
**A. MASHEK**

DRAWN BY:  
**B. LEIKER**

REVIEWED BY:  
**R. BARUTH**

SUBMITTED BY:  
**CHARLES LOUDON  
PROJECT MANAGER  
BURNS & McDONNELL  
ENGINEERS, INC.**

PLOT SCALE:  
**AS SHOWN**

DESIGN FILE:  
**FS10CFC-110.DGN**

PLOT DATE:  
**XX - XXX - 2009**

**FORT SILL ARMY POST  
OKLAHOMA**

PDC: 65299

**CENTRAL ISSUE FACILITY  
(CIF)**

FY: 10

**SITE PLAN**

|            |                |                        |
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| DWG. CODE: | CONTRACT DATE: | SHEET REFERENCE NUMBER |
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**C110**



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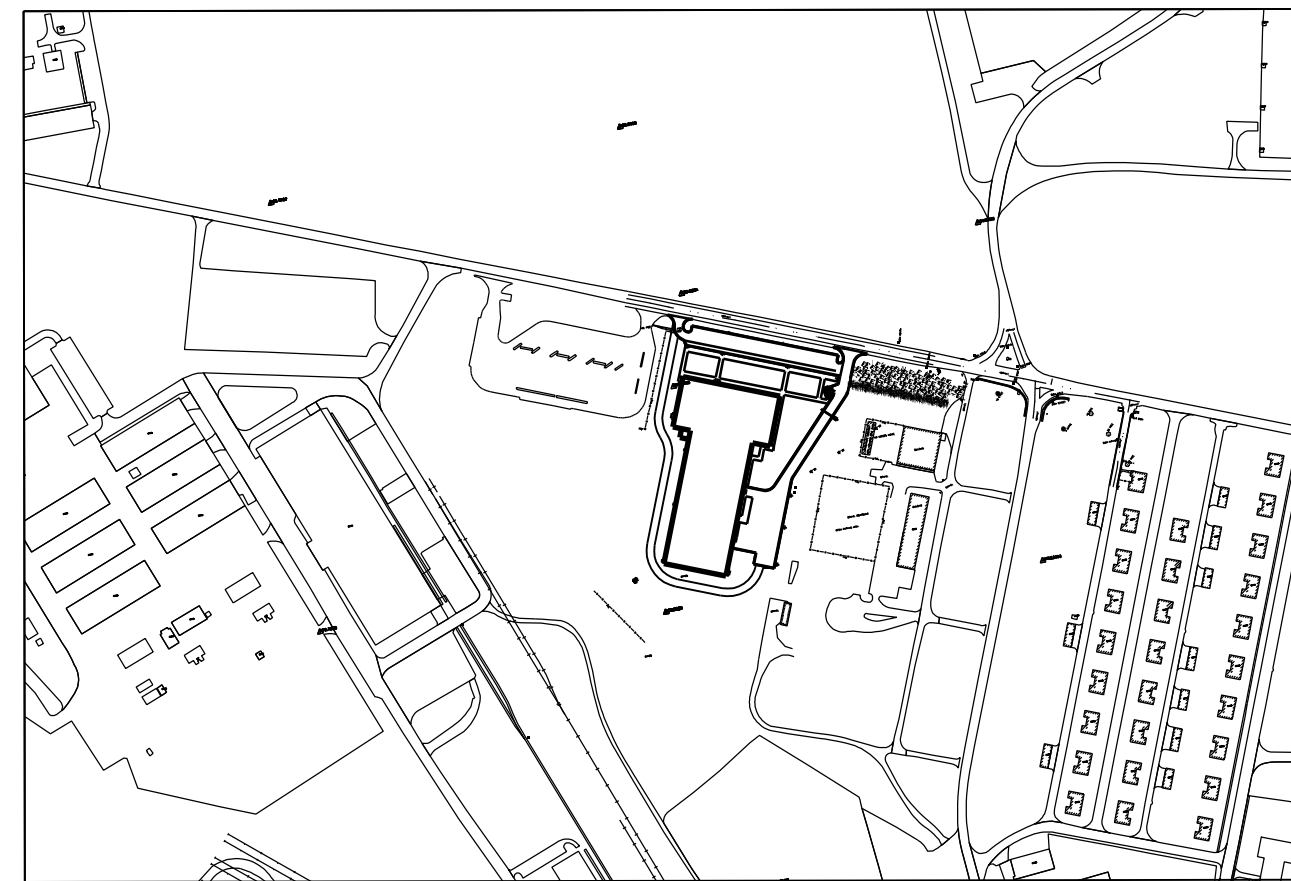
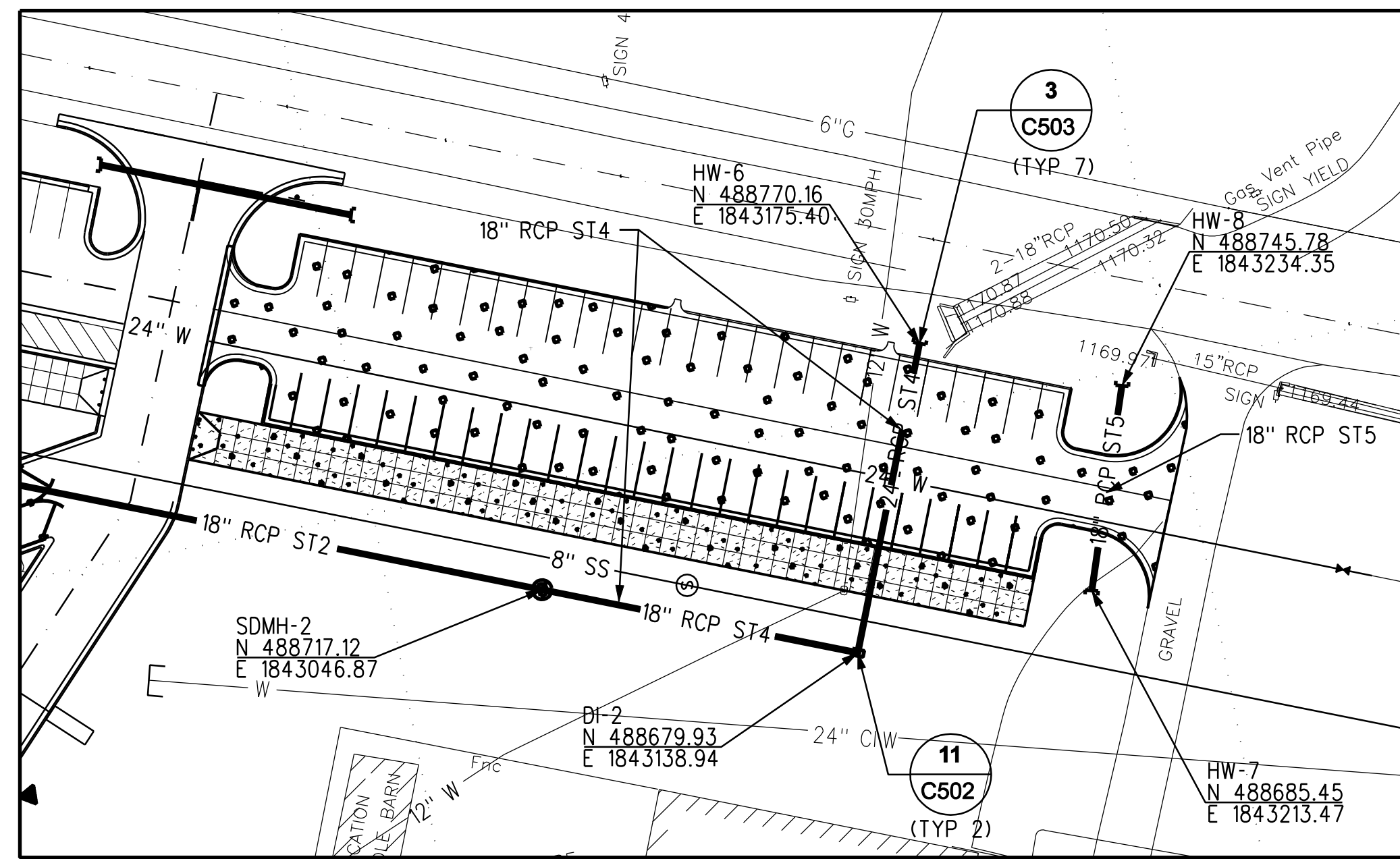
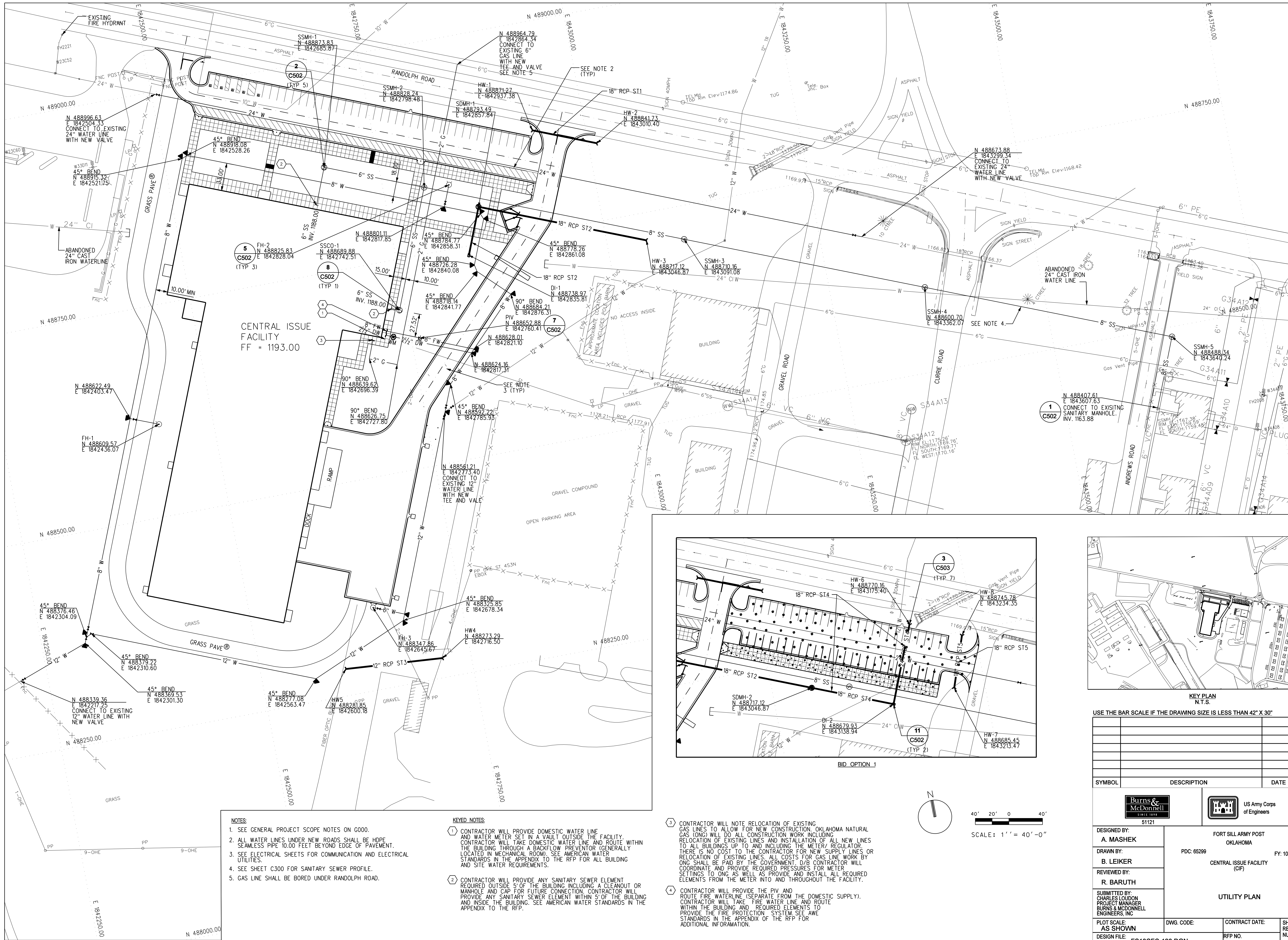
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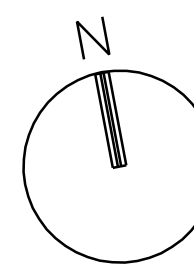
NOTES:

1. SEE GENERAL PROJECT SCOPE NOTES ON G000.
2. ALL WATER LINES UNDER NEW ROADS SHALL BE HDPE SEAMLESS PIPE 10.00 FEET BEYOND EDGE OF PAVEMENT.
3. SEE ELECTRICAL SHEETS FOR COMMUNICATION AND ELECTRICAL UTILITIES.
4. SEE SHEET C300 FOR SANITARY SEWER PROFILE.
5. GAS LINE SHALL BE BORED UNDER RANDOLPH ROAD.

KEYED NOTES:

1. CONTRACTOR WILL PROVIDE DOMESTIC WATER LINE AND WATER METER SET IN A VAULT OUTSIDE THE FACILITY. CONTRACTOR WILL TAKE DOMESTIC WATER LINE AND ROUTE WITHIN THE BUILDING THROUGH A BACKFLOW PREVENTOR (GENERALLY LOCATED IN MECHANICAL ROOM). SEE AMERICAN WATER STANDARDS IN THE APPENDIX TO THE RFP FOR ALL BUILDING AND SITE WATER REQUIREMENTS.
2. CONTRACTOR WILL PROVIDE ANY SANITARY SEWER ELEMENT REQUIRED OUTSIDE 5' OF THE BUILDING INCLUDING A CLEANOUT OR MANHOLE AND CAP FOR FUTURE CONNECTION. CONTRACTOR WILL PROVIDE ANY SANITARY SEWER ELEMENT WITHIN 5' OF THE BUILDING AND INSIDE THE BUILDING. SEE AMERICAN WATER STANDARDS IN THE APPENDIX TO THE RFP.

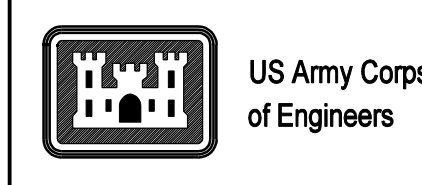
3. CONTRACTOR WILL NOTE RELOCATION OF EXISTING GAS LINES TO ALLOW FOR NEW CONSTRUCTION. OKLAHOMA NATURAL GAS (ONG) WILL DO ALL CONSTRUCTION WORK INCLUDING RELOCATION OF EXISTING LINES AND INSTALLATION OF ALL NEW LINES TO ALL BUILDINGS UP TO AND INCLUDING THE METER/REGULATOR. THERE IS NO COST TO THE CONTRACTOR FOR NEW SUPPLY LINES OR RELOCATION OF EXISTING LINES. ALL COSTS FOR GAS LINE WORK BY ONG SHALL BE PAID BY THE GOVERNMENT. D/B CONTRACTOR WILL COORDINATE AND PROVIDE REQUIRED PRESSURES FOR METER SETTINGS TO ONG AS WELL AS PROVIDE AND INSTALL ALL REQUIRED ELEMENTS FROM THE METER INTO AND THROUGHOUT THE FACILITY.
4. CONTRACTOR WILL PROVIDE THE PIV AND ROUTE FIRE WATERLINE (SEPARATE FROM THE DOMESTIC SUPPLY). CONTRACTOR WILL TAKE FIRE WATER LINE AND ROUTE WITHIN THE BUILDING AND REQUIRED ELEMENTS TO PROVIDE THE FIRE PROTECTION SYSTEM. SEE AWE STANDARDS IN THE APPENDIX OF THE RFP FOR ADDITIONAL INFORMATION.



40' 20' 0 40'  
SCALE: 1" = 40'-0"

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

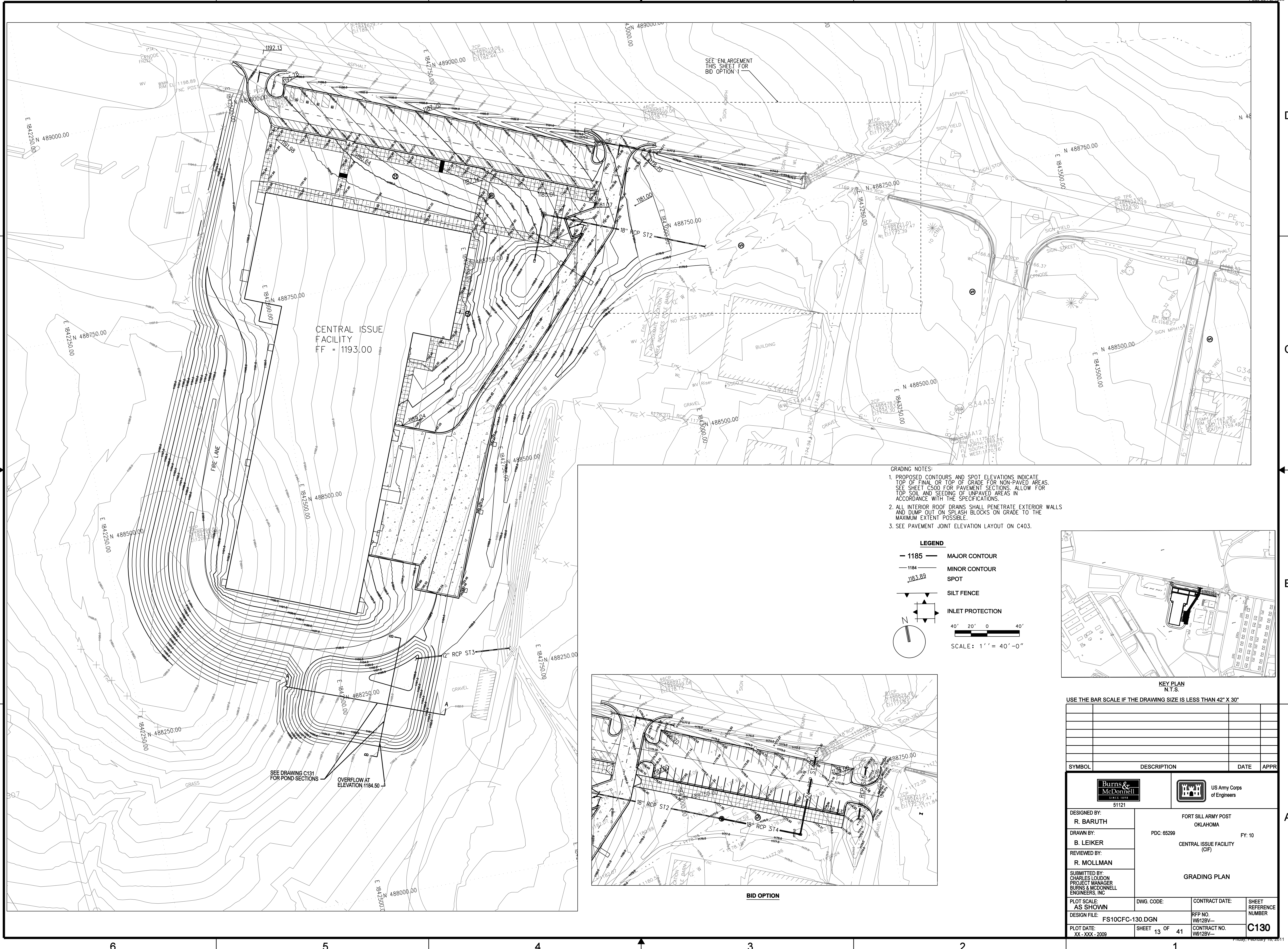
| SYMBOL | DESCRIPTION | DATE | APPR |
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| DESIGNED BY:<br>A. MASHEK  | PDC: 65299<br><br>CENTRAL ISSUE FACILITY<br>(CIF) | FORT SILL ARMY POST<br>OKLAHOMA<br><br>FY: 10 |  |
| DRAWN BY:<br>B. LEIKER   |   |   |  |
| REVIEWED BY:<br>R. BARUTH  |   |   |  |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |   |   |  |
| UTILITY PLAN   |   |   |  |


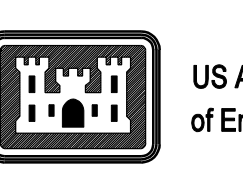
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| PLOT SCALE:<br><b>AS SHOWN</b>         | DWG. CODE:        | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br><b>FS10CFC-120.DGN</b> |                   | RFP NO.<br>W9126V--      | <b>C120</b>                  |
| PLOT DATE:<br>XX - XXX - 2009          | SHEET<br>12 OF 41 | CONTRACT NO.<br>W9126V-- |                              |





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USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL   | DESCRIPTION       | DATE                            | APPR                         |
|--|-------------------|---------------------------------|------------------------------|
| <div><div><div>51121</div></div><div><div>US Army Corps of Engineers</div></div></div> |                   |                                 |                              |
| DESIGNED BY:<br><b>R. BARUTH</b>   |                   | FORT SILL ARMY POST<br>OKLAHOMA |                              |
| DRAWN BY:<br><b>B. LEIKER</b>  |                   | PDC: 65299 FY: 10               |                              |
| REVIEWED BY:<br><b>R. MOLLMAN</b>  |                   | CENTRAL ISSUE FACILITY<br>(CIF) |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC.   |                   | GRADING PLAN                    |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:        | CONTRACT DATE:                  | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFC-130.DGN  |                   | RFP NO.<br>W9126V—              | <b>C130</b>                  |
| PLOT DATE:<br>XX-XXX-2009  | SHEET<br>13 OF 41 | CONTRACT NO.<br>W9126V—         |                              |

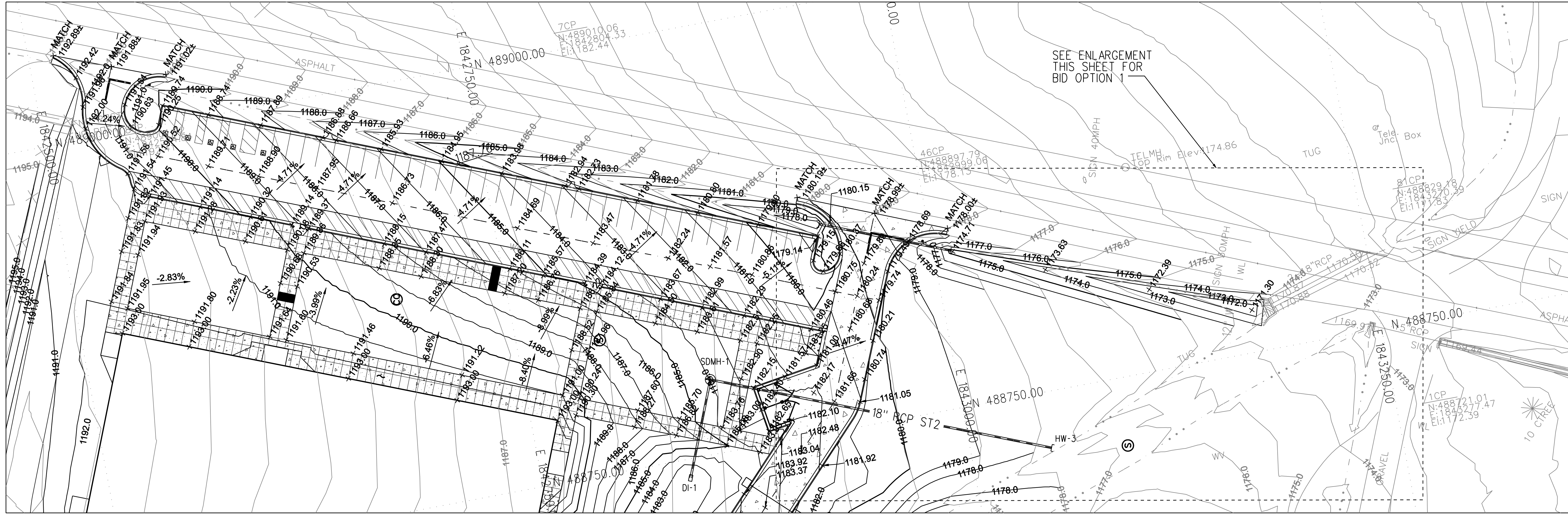


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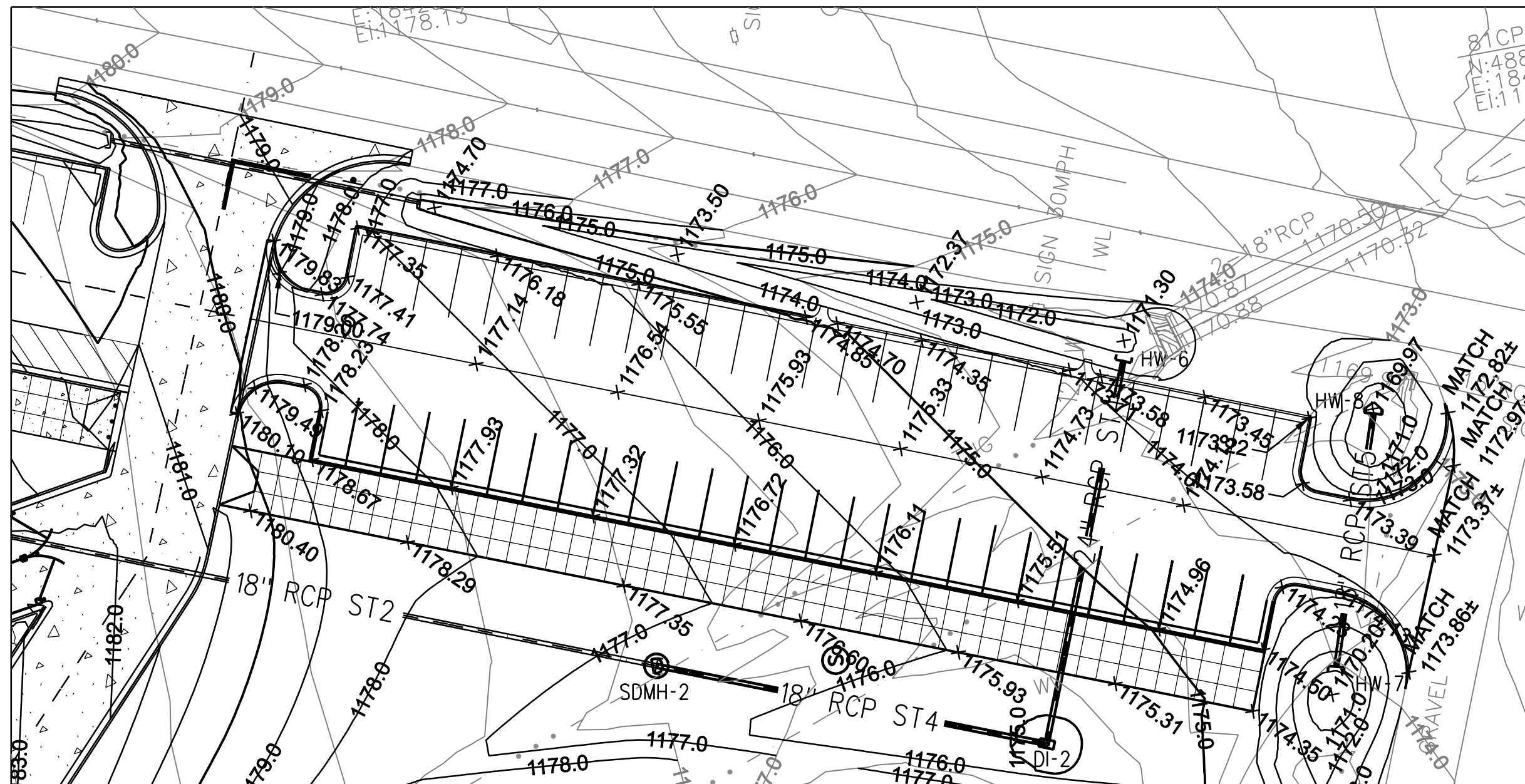
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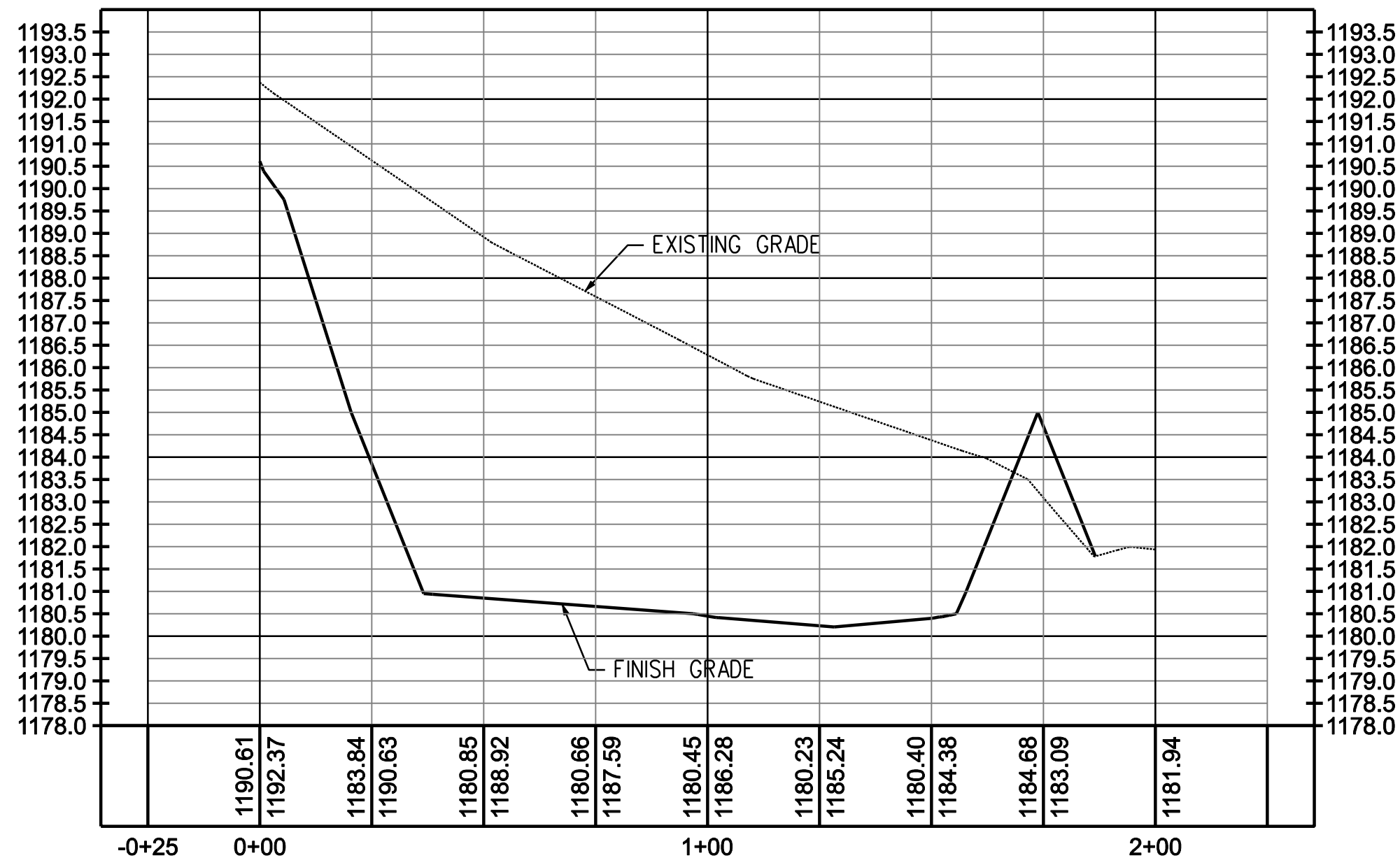
- GRADING NOTES:
1. PROPOSED CONTOURS AND SPOT ELEVATIONS INDICATE TOP OF FINAL OR TOP OF GRADE FOR NON-PAVED AREAS. SEE SHEET C500 FOR PAVEMENT SECTIONS. ALLOW FOR TOP SOIL AND SEEDING OF UNPAVED AREAS IN ACCORDANCE WITH THE SPECIFICATIONS.
  2. ALL INTERIOR ROOF DRAINS SHALL PENETRATE EXTERIOR WALLS AND DUMP OUT ON SPLASH BLOCKS ON GRADE TO THE MAXIMUM EXTENT POSSIBLE.
  3. SEE PAVEMENT JOINT ELEVATION LAYOUT ON C403.

**LEGEND**

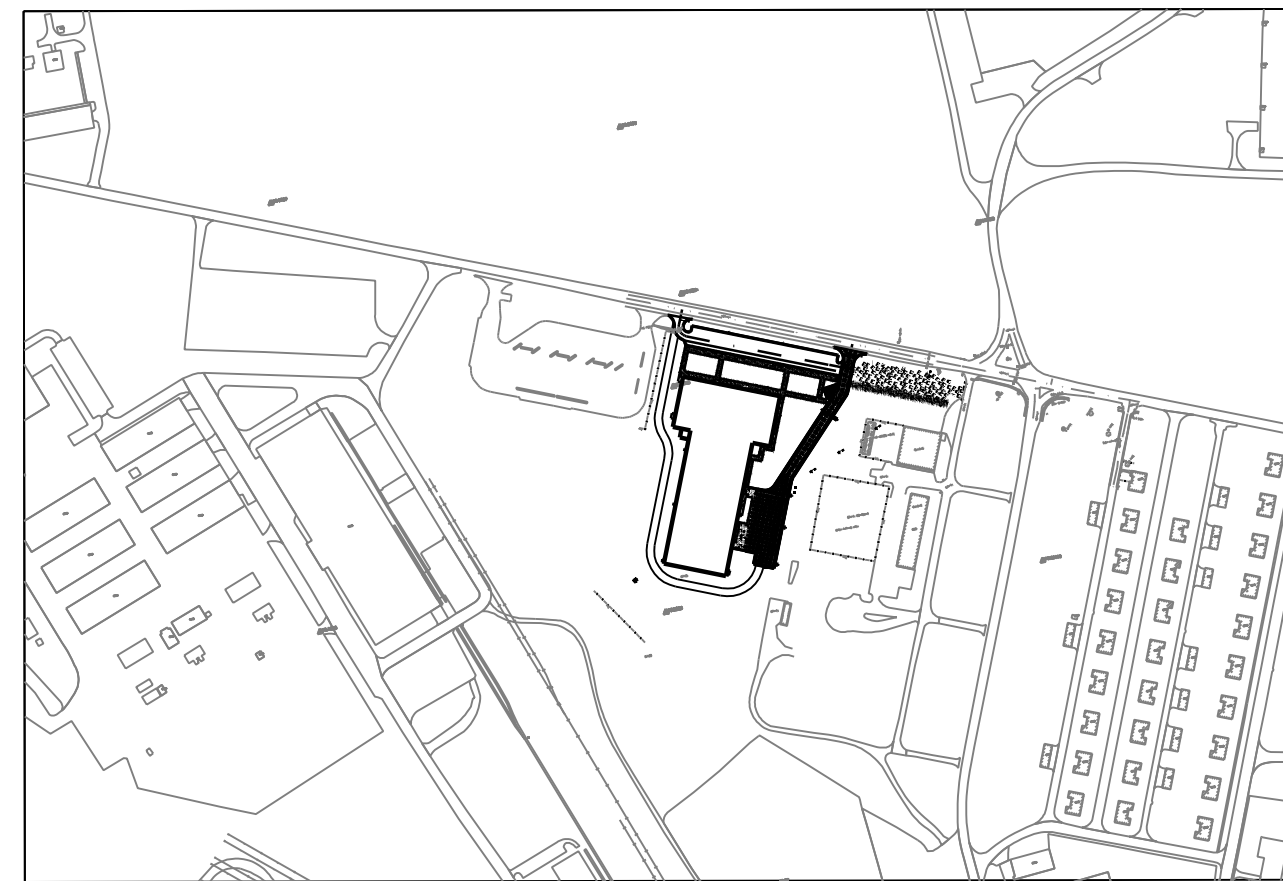
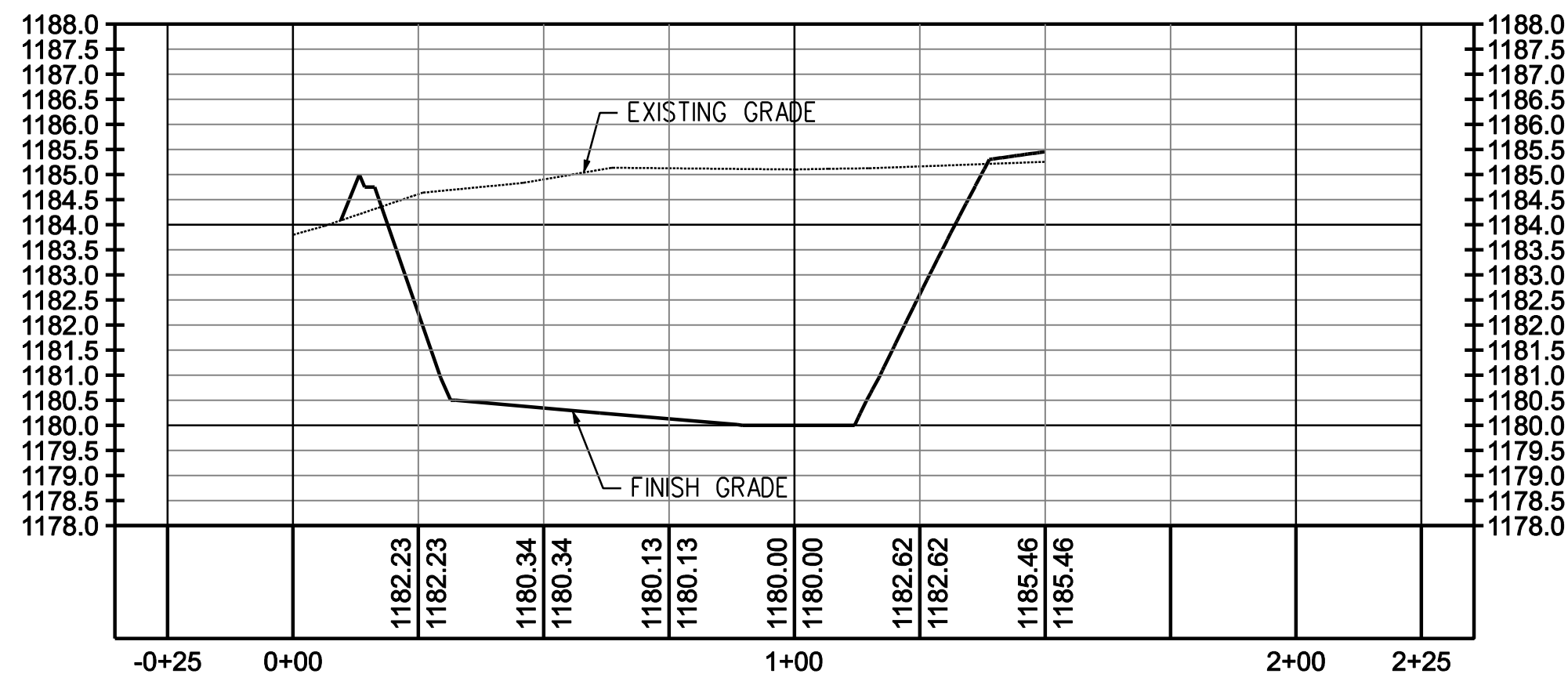
— 1185 — MAJOR CONTOUR  
— 1184 — MINOR CONTOUR  
1183.89 SPOT



Profile View of Pond Section A




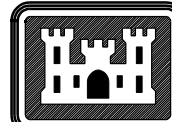
Profile View of Pond Section B

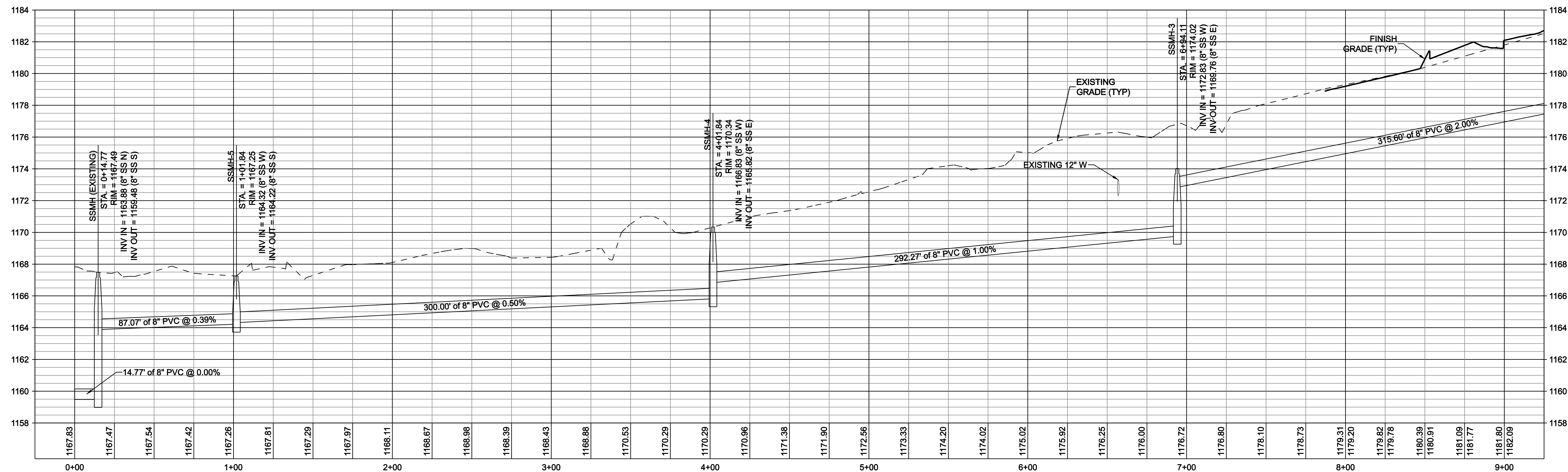


KEY PLAN  
N.T.S.

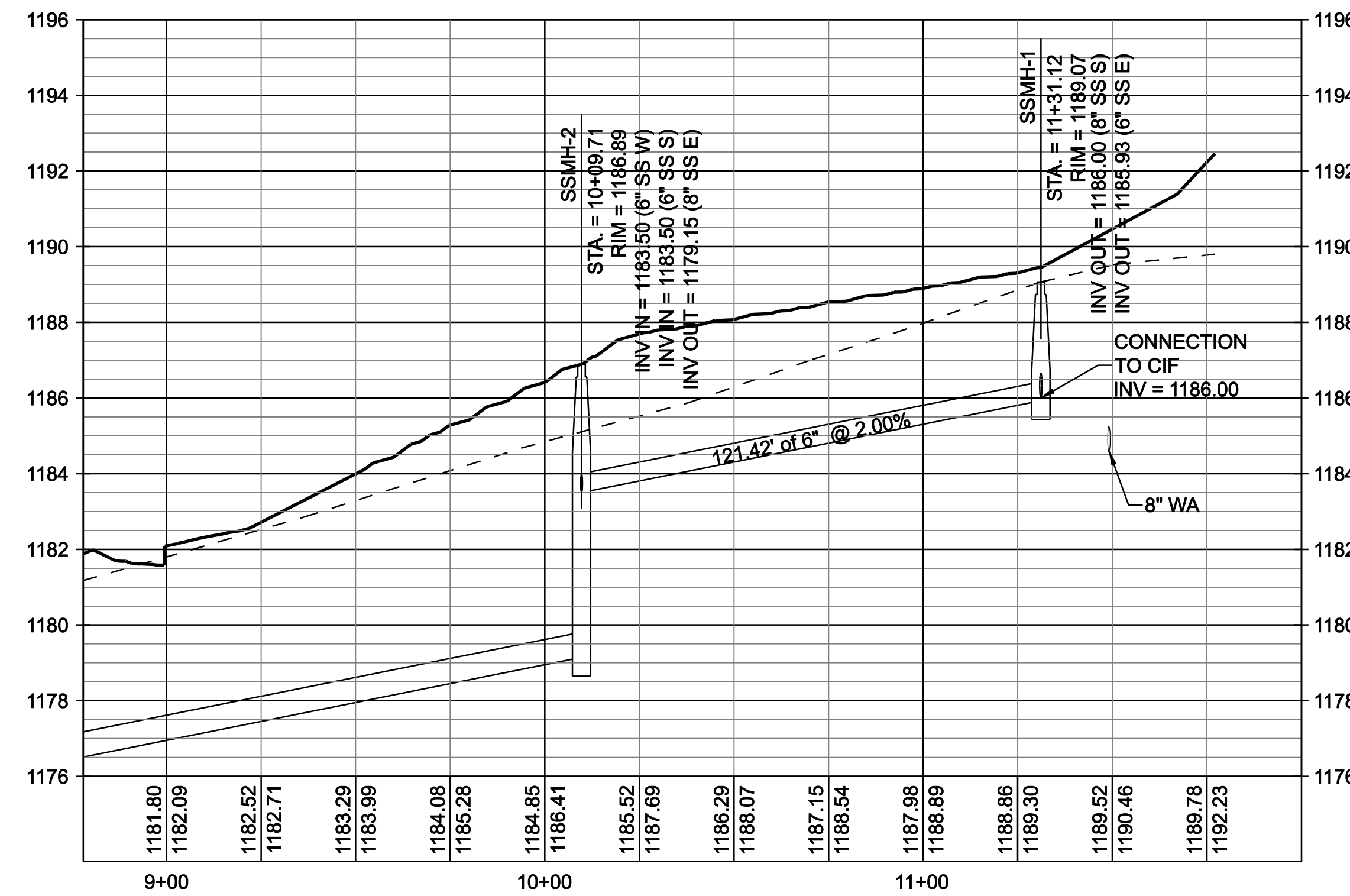
USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL | DESCRIPTION | DATE | APPR |
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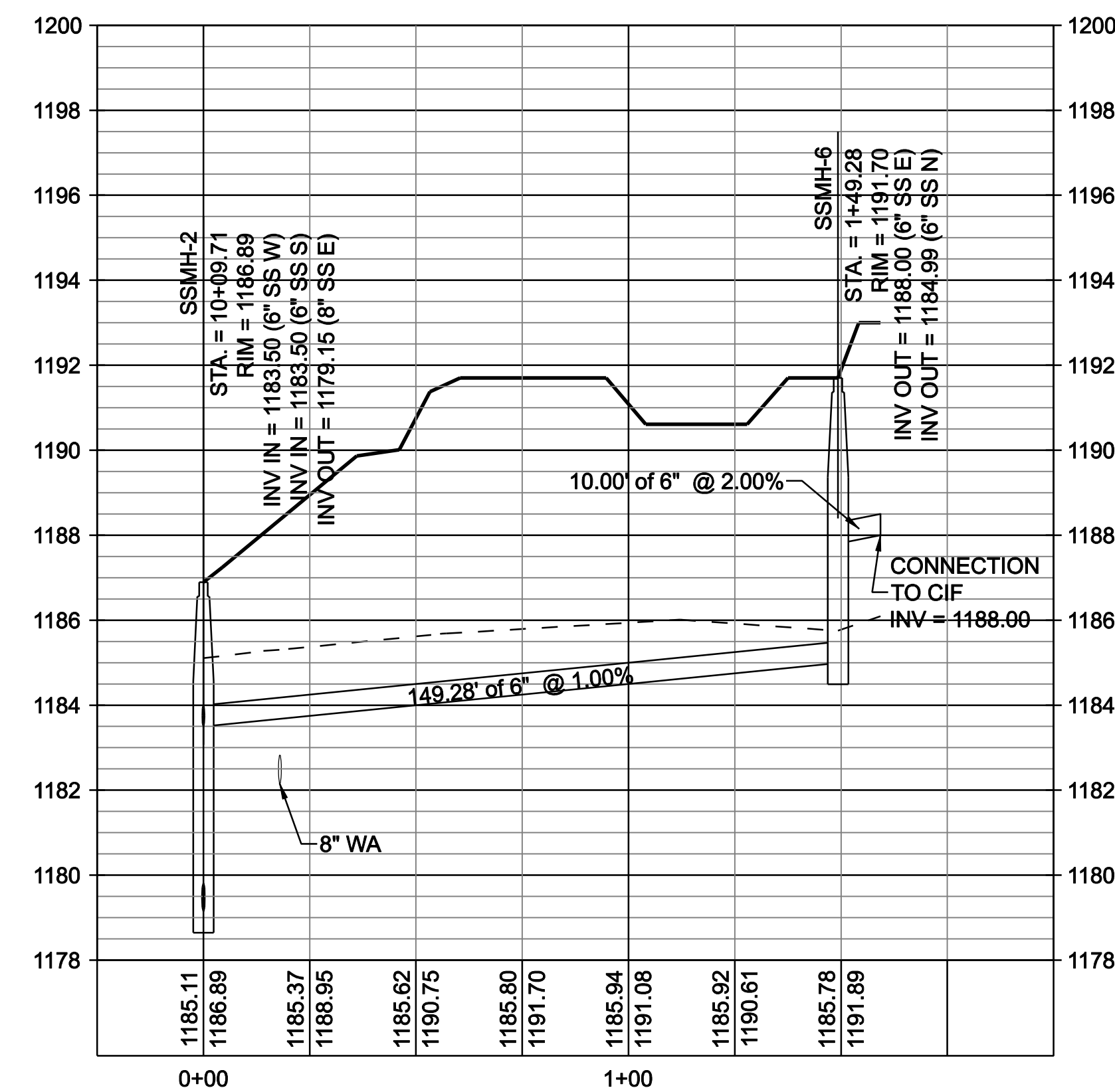
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|--|---------------------------------|---|------------------------------|
| <div><div>51121</div></div> |                                 | <div><div>US Army Corps<br/>of Engineers</div></div> |                              |
| DESIGNED BY:<br>R. BARUTH  |                                 | FORT SILL ARMY POST<br>OKLAHOMA   |                              |
| DRAWN BY:<br>B. LEIKER   | PDC: 65299                      | FY: 10  |                              |
| REVIEWED BY:<br>R. MOLLMAN   | CENTRAL ISSUE FACILITY<br>(CIF) |   |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC.                       |                                 | GRADING<br>ENLARGEMENT PLANS/<br>POND SECTION   |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:                      | CONTRACT DATE:  | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFC-131.DGN  |                                 | RFP NO.<br>W912BV—  |                              |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>14 OF 41               | CONTRACT NO.<br>W912BV—   | C131                         |



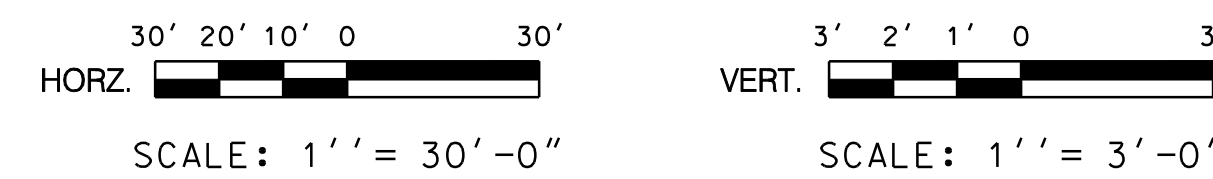
SS1 PROFILE



SS1 PROFILE


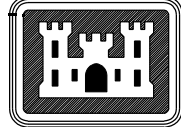


SS1A PROFILE



- NOTE:
1. SANITARY SEWER MUST HAVE A MINIMUM 30" COVER. SEE SPECIFICATION 02 3 10 GRAVITY SANITARY SEWERS FOR FURTHER INFORMATION.

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL   | DESCRIPTION   | DATE                     | APPR                         |
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|       |                              |                          |                              |
| DESIGNED BY:<br>A. MASHEK  | FORT SILL ARMY POST<br>OKLAHOMA<br>PDC: 65299<br>CENTRAL ISSUE FACILITY<br>(CIF)<br><br>SANITARY SEWER<br>PROFILE |                          |                              |
| DRAWN BY:<br>B. LEIKER   |   |                          |                              |
| REVIEWED BY:<br>R. BARUTH  |   |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC. |   |                          |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:  | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFC-300.DGN  |   | RFP NO.<br>W912BV--      |                              |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>15 OF 41   | CONTRACT NO.<br>W912BV-- | <b>C300</b>                  |



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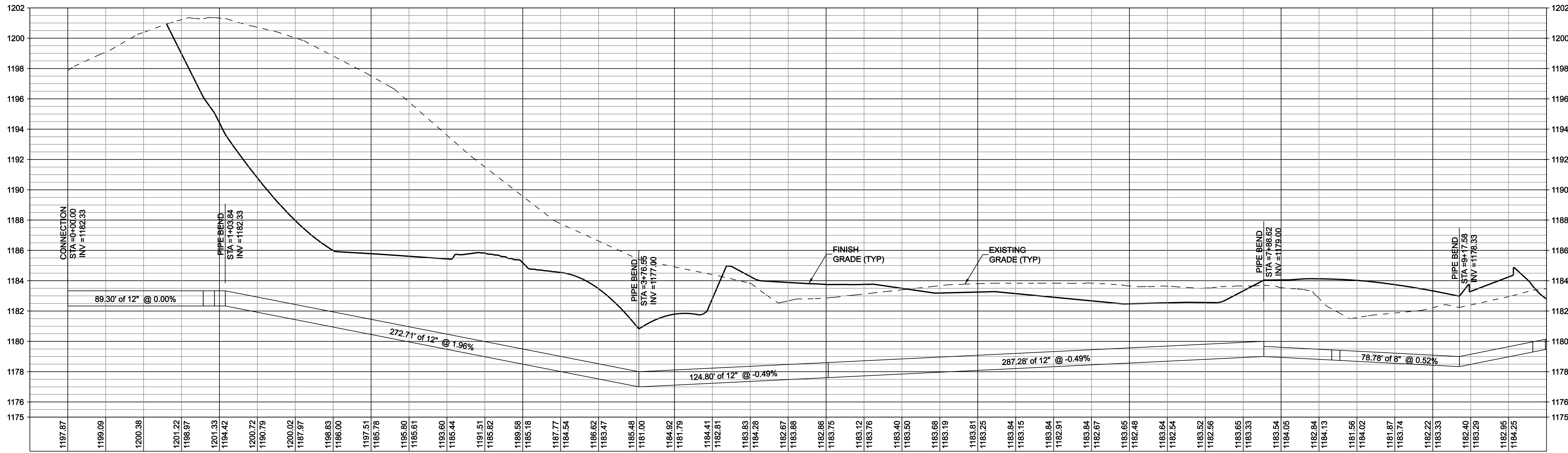
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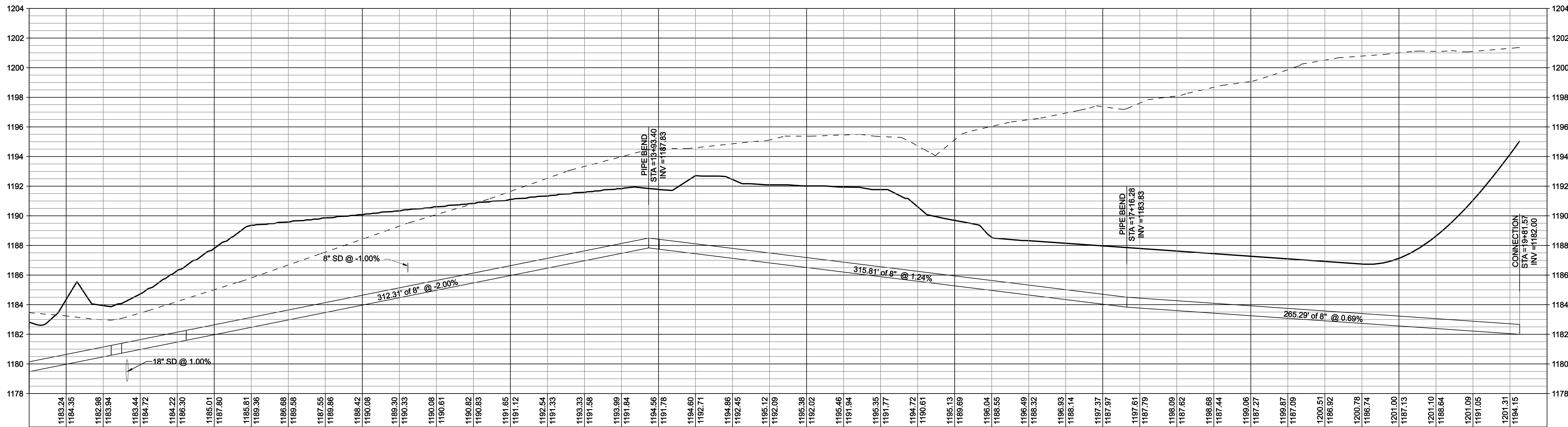
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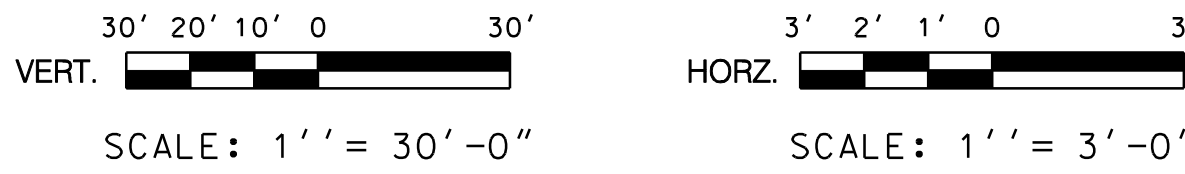
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WA1 PROFILE



WA1 PROFILE



USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL   | DESCRIPTION  | DATE                     | APPR  |
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|       |  |                          |   |
| DESIGNED BY:<br>A. MASHEK  | FORT SILL ARMY POST<br>OKLAHOMA<br>PDC: 65299<br>CENTRAL ISSUE FACILITY (CIF)<br><br>WATER PROFILE | FY: 10                   | SHEET<br>REFERENCE<br>NUMBER<br><br><b>C301</b> |
| DRAWN BY:<br>B. LEIKER   |  |                          |   |
| REVIEWED BY:<br>R. BARUTH  |  |                          |   |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |  |                          |   |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:   | CONTRACT DATE:           |   |
| DESIGN FILE:<br>FS10CFC-301.DGN  |  | RFP NO.<br>W912BV--      |   |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>16 OF 41  | CONTRACT NO.<br>W912BV-- |   |

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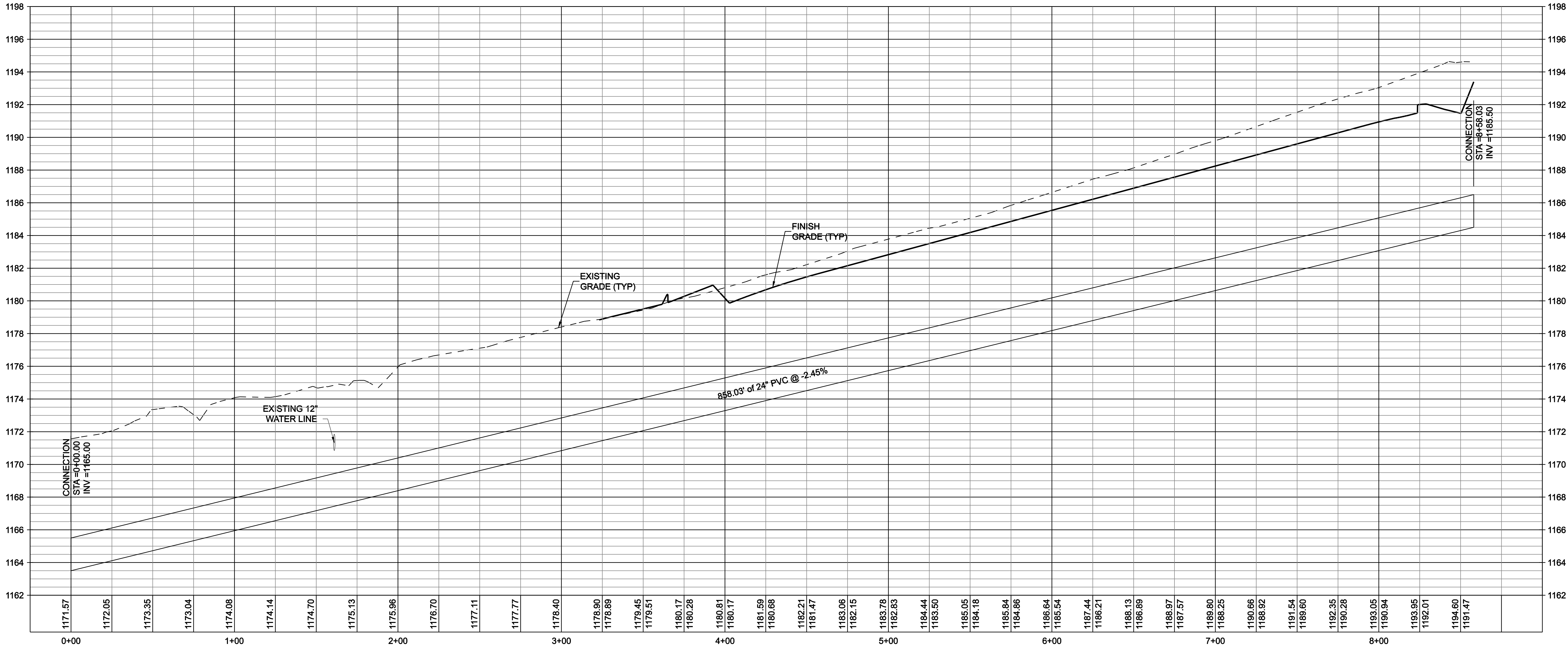
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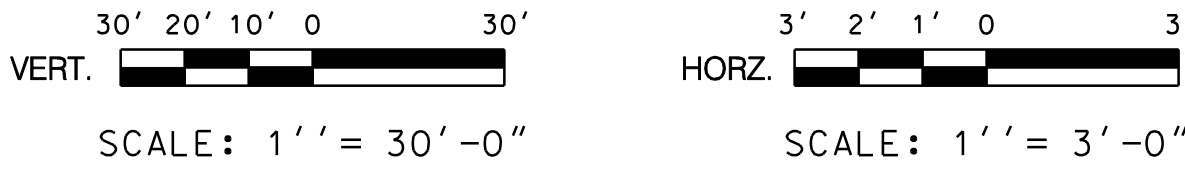
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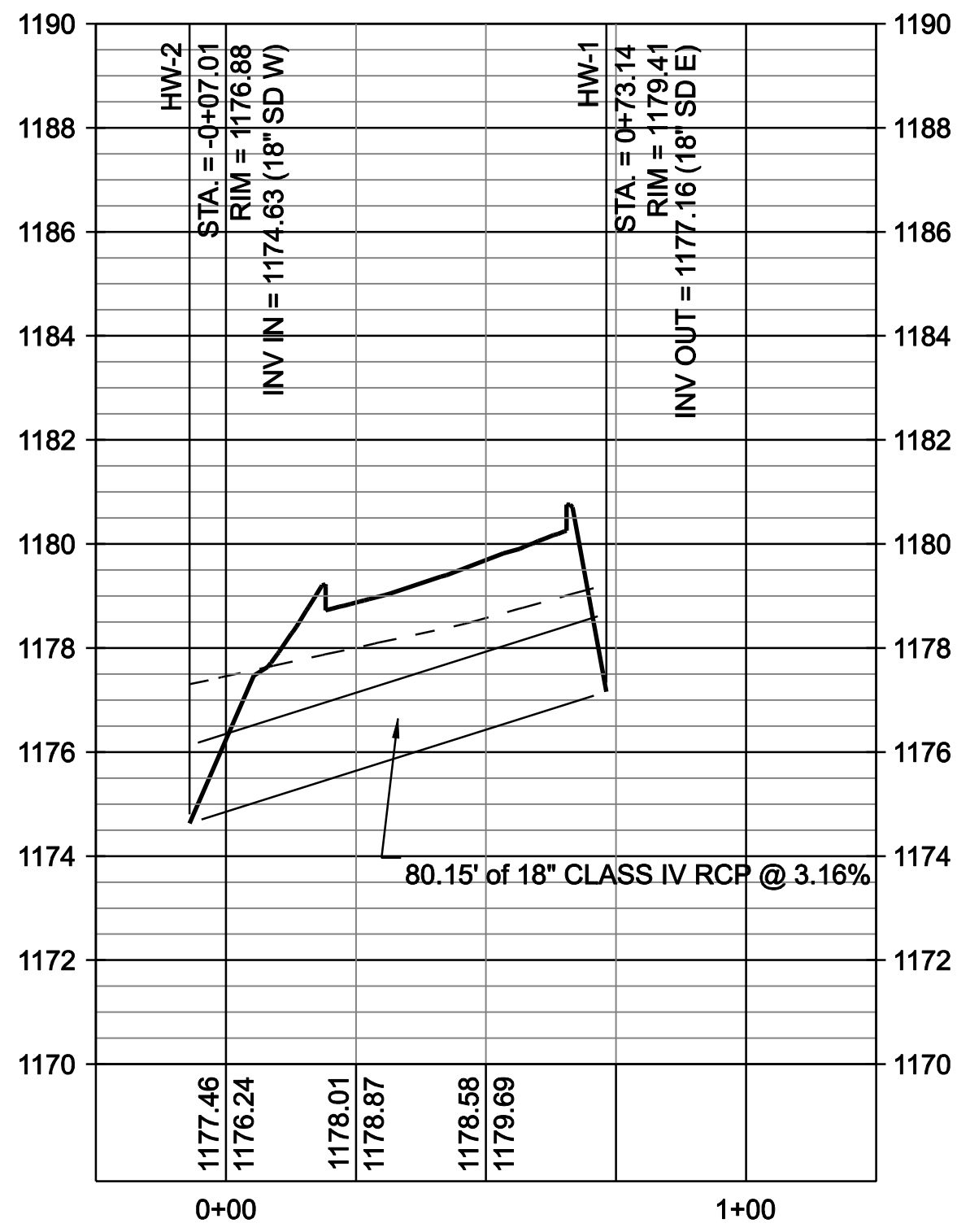
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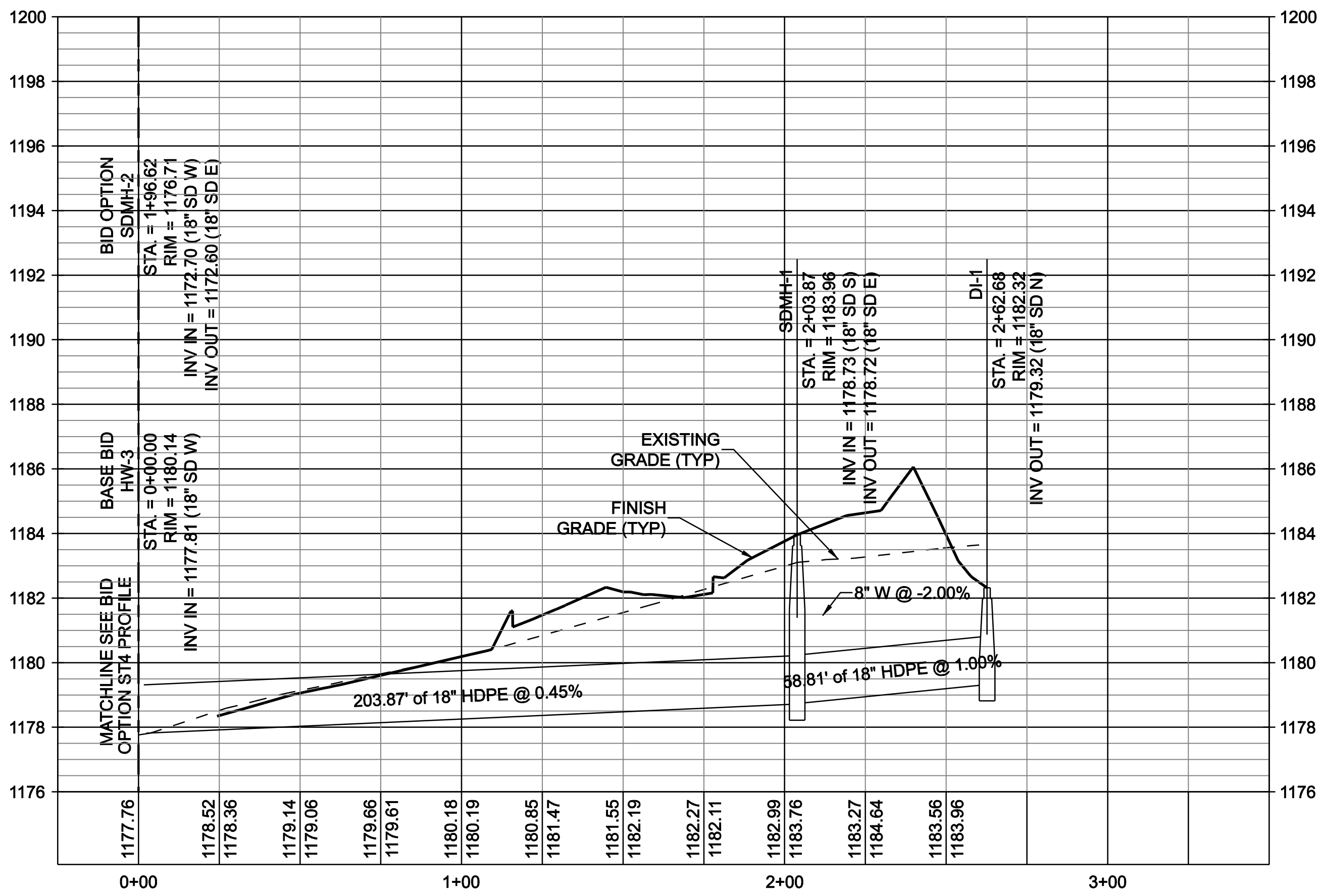


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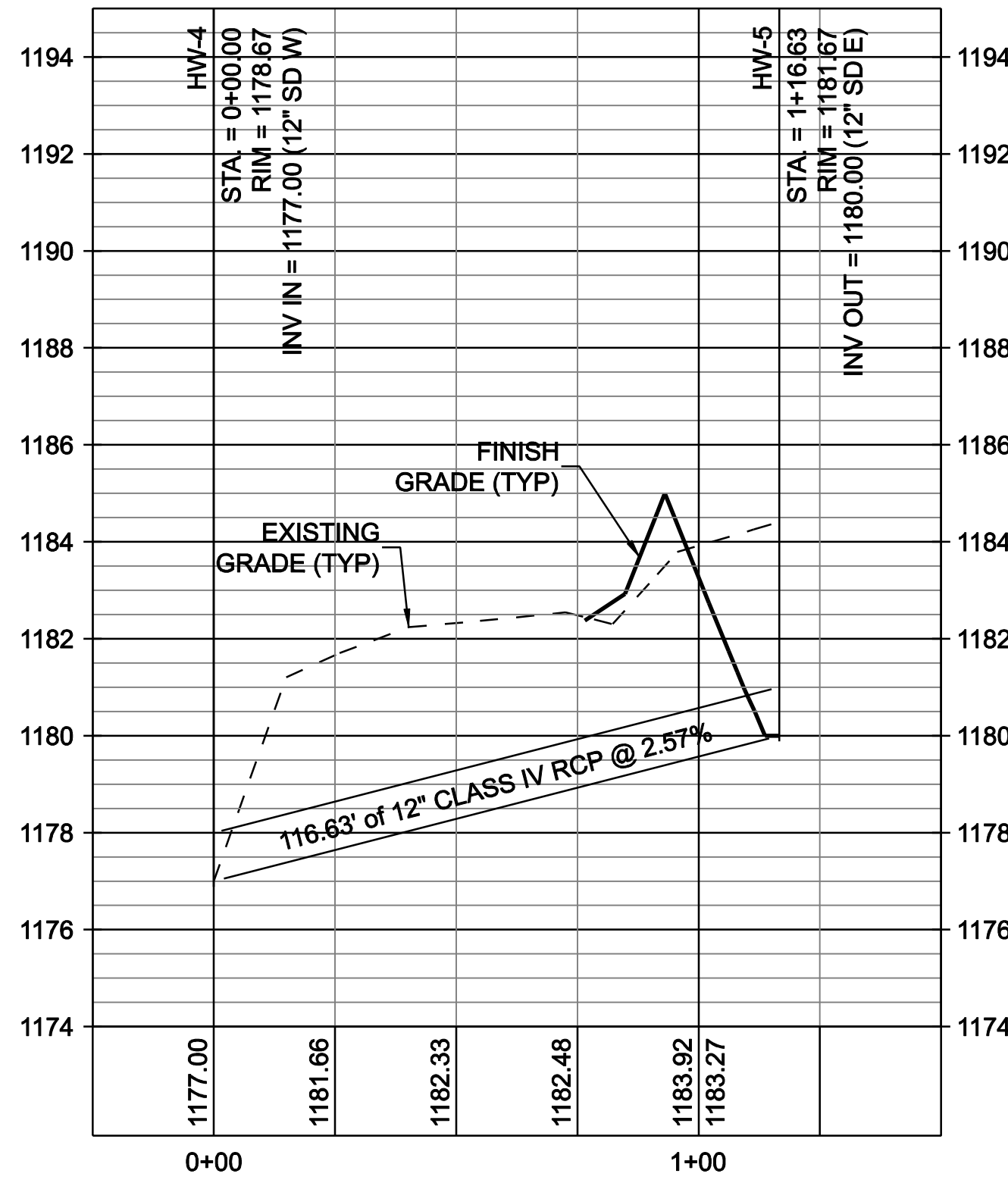




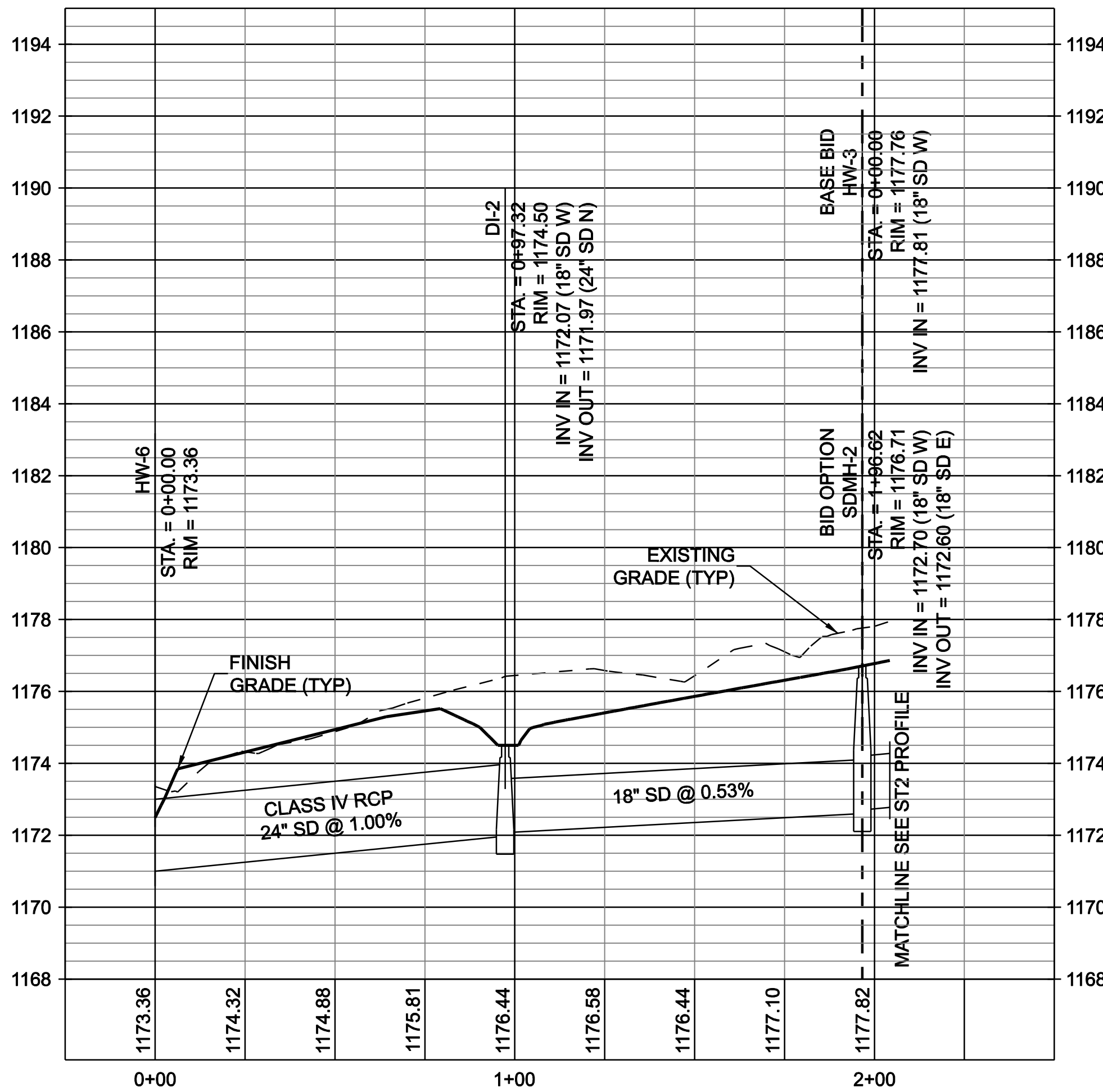
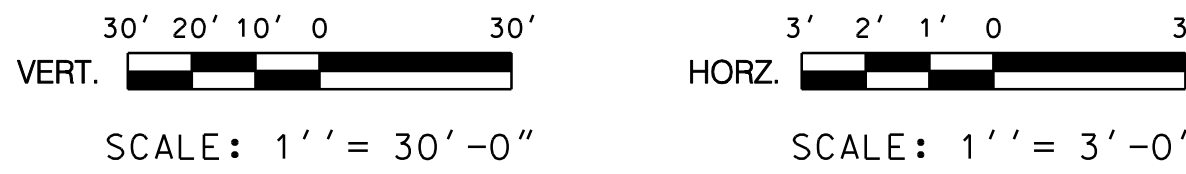
ST1 PROFILE



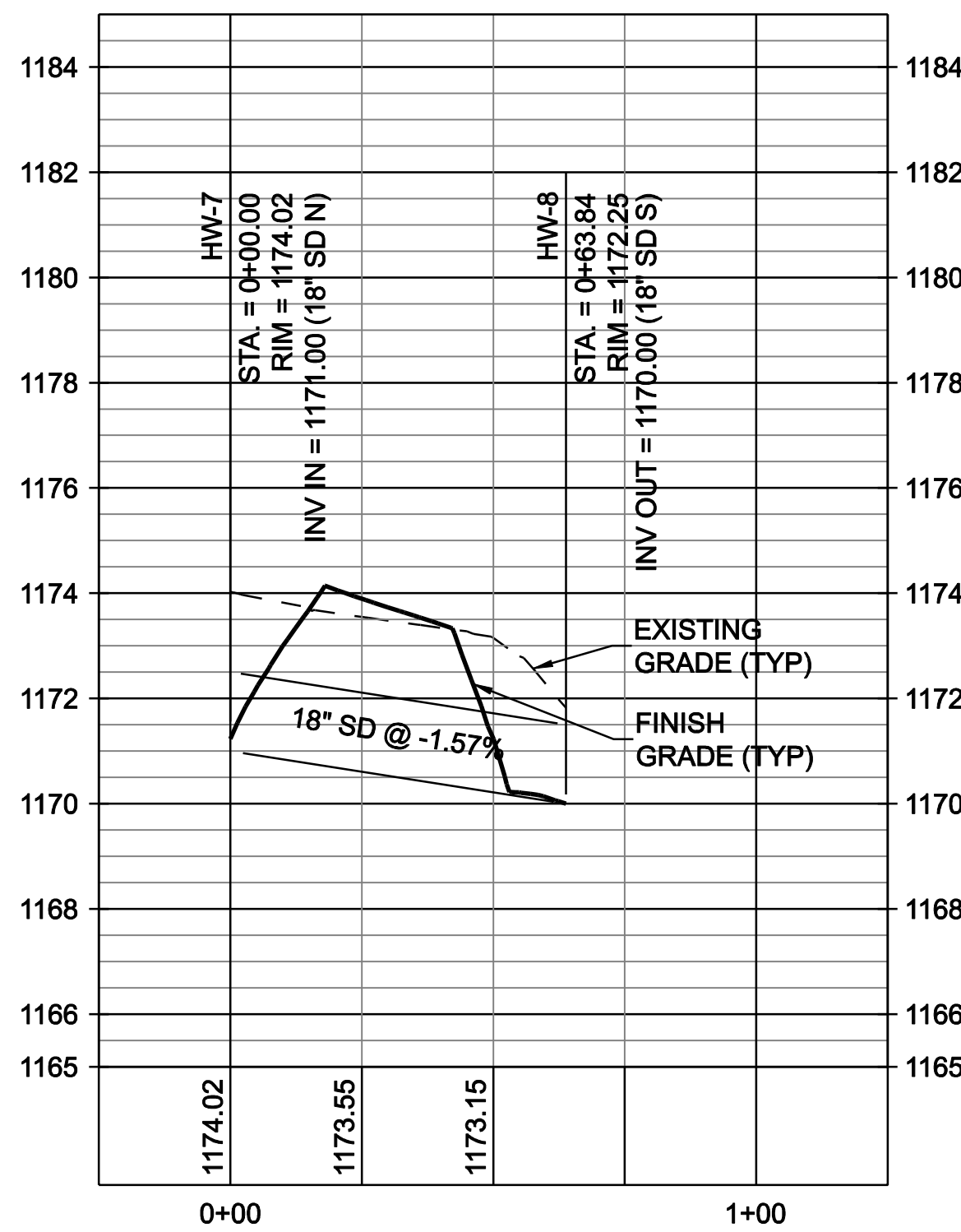
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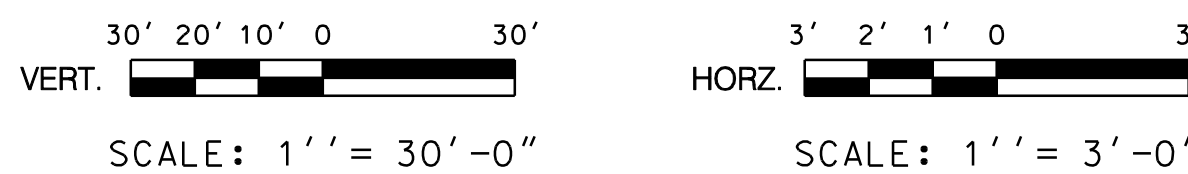
ST3 PROFILE



ST4 PROFILE



ST5 PROFILE



USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

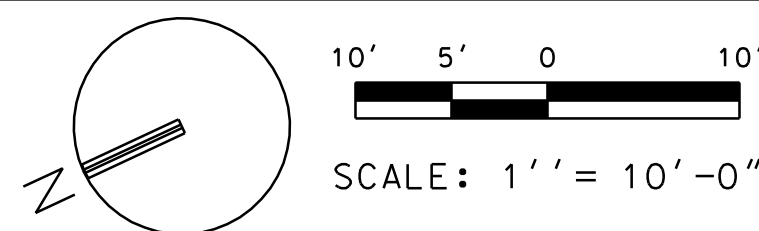
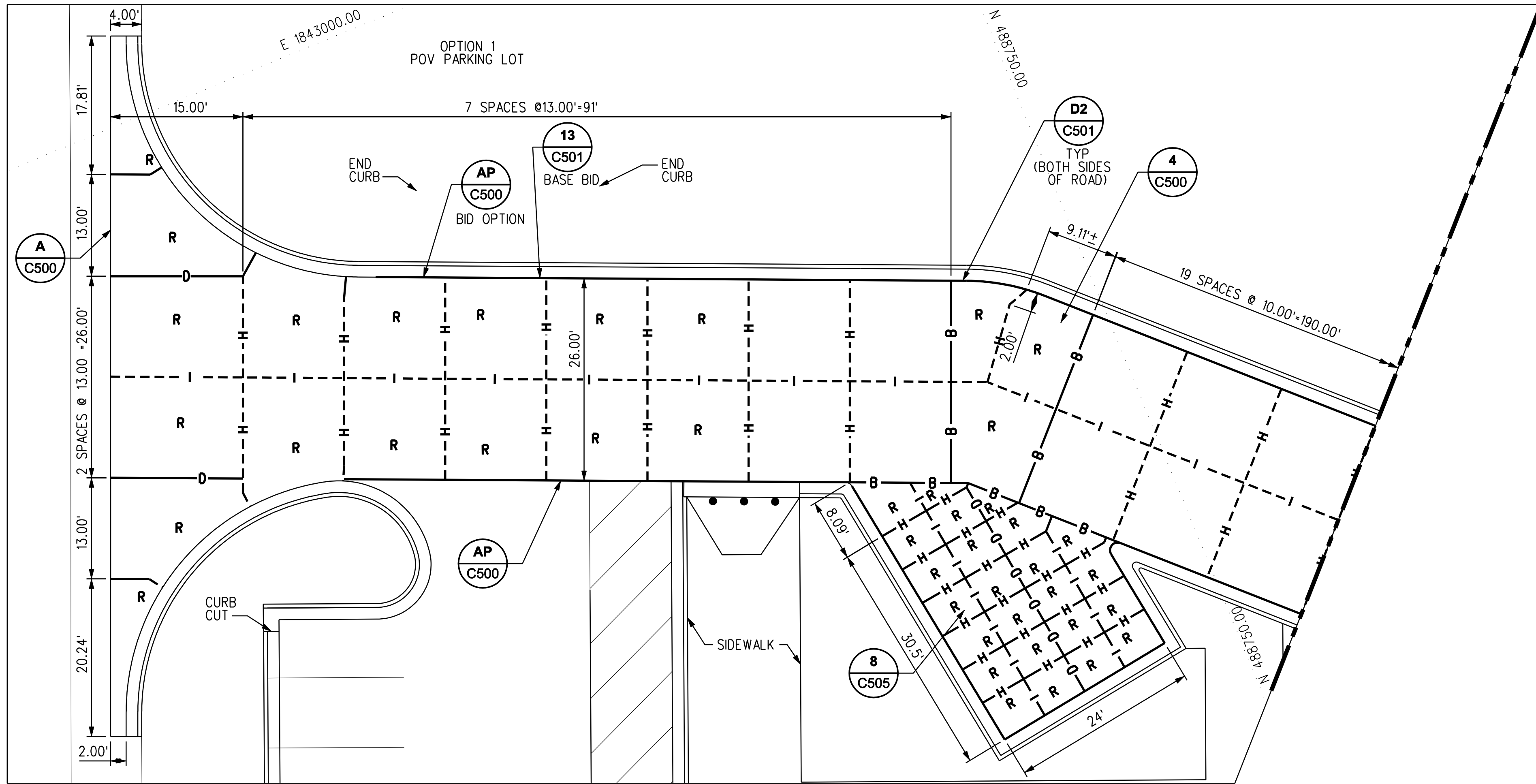
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D

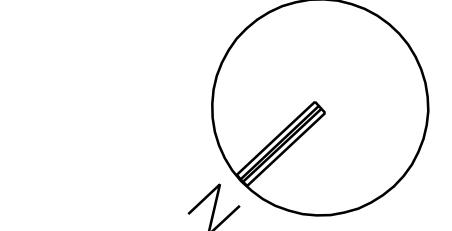
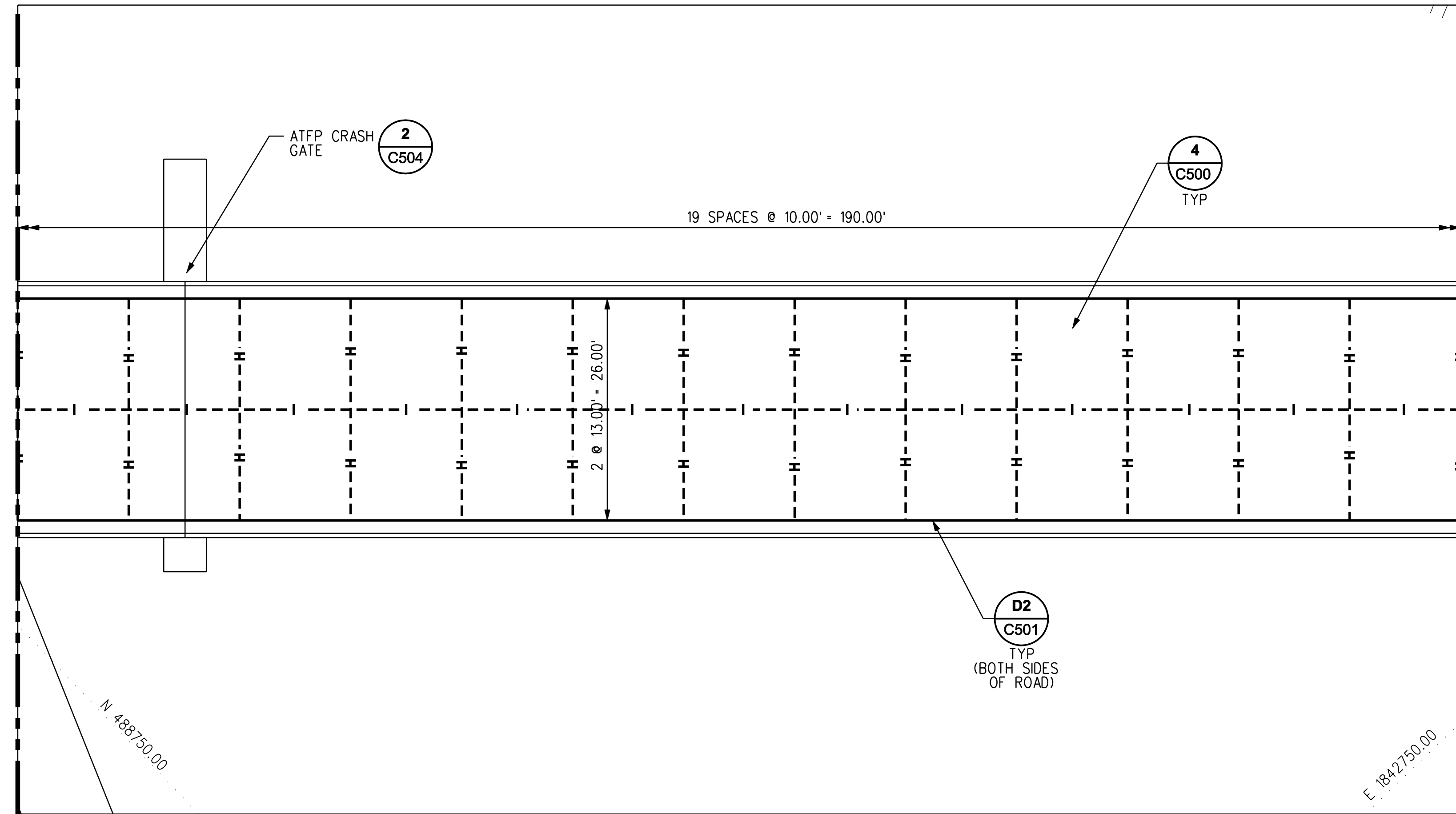
C

B

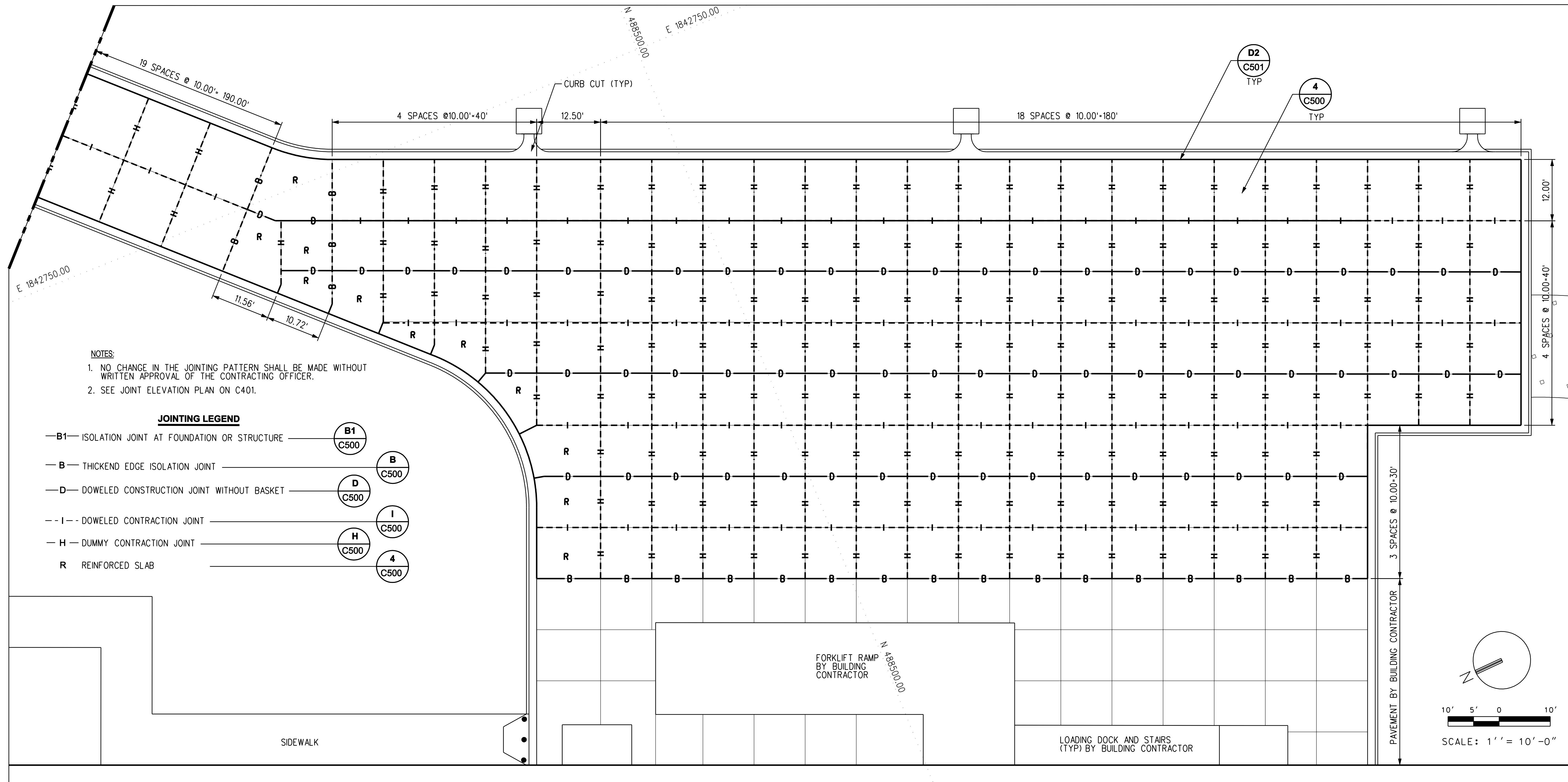
A



SCALE: 1" = 10'-0"



SCALE: 1" = 10'-0"

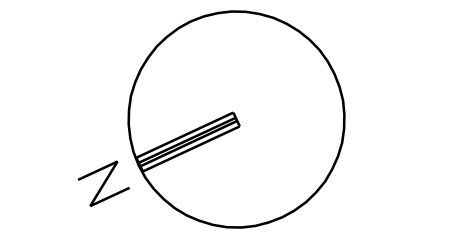


- NOTES:
1. NO CHANGE IN THE JOINTING PATTERN SHALL BE MADE WITHOUT WRITTEN APPROVAL OF THE CONTRACTING OFFICER.
  2. SEE JOINT ELEVATION PLAN ON C401.

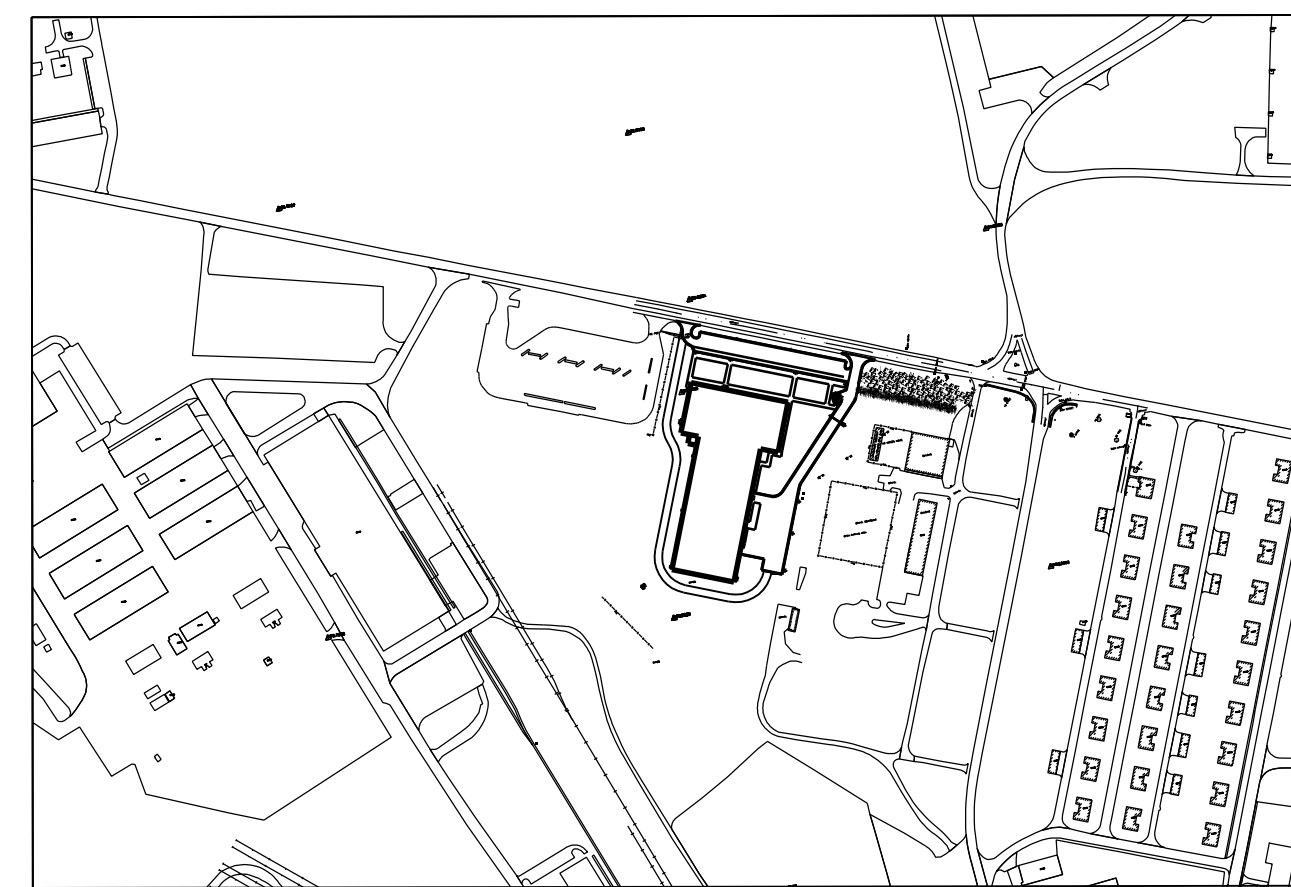
**JOINTING LEGEND**

- B1— ISOLATION JOINT AT FOUNDATION OR STRUCTURE
- B— THICKEND EDGE ISOLATION JOINT
- D— DOWELED CONSTRUCTION JOINT WITHOUT BASKET
- I--- DOWELED CONTRACTION JOINT
- H— DUMMY CONTRACTION JOINT
- R REINFORCED SLAB

- B1 C500
- B C500
- D C500
- I C500
- H C500
- 4 C500



SCALE: 1" = 10'-0"



KEY PLAN  
N.T.S.

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL | DESCRIPTION | DATE | APPR |
|--------|-------------|------|------|
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |



DESIGNED BY:  
**A. MASHEK**

DRAWN BY:  
**B. LEIKER**

REVIEWED BY:  
**R. BARUTH**

SUBMITTED BY:  
**CHARLES LOUDON  
PROJECT MANAGER  
BURNS & McDONNELL  
ENGINEERS, INC.**

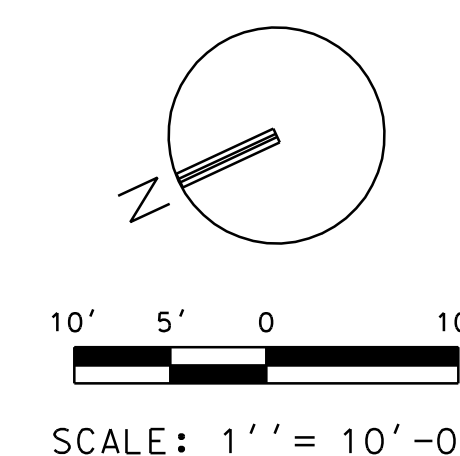
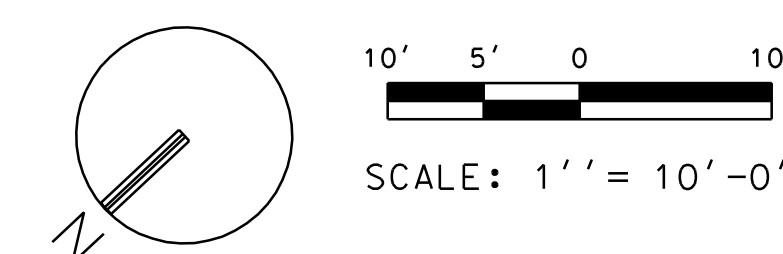
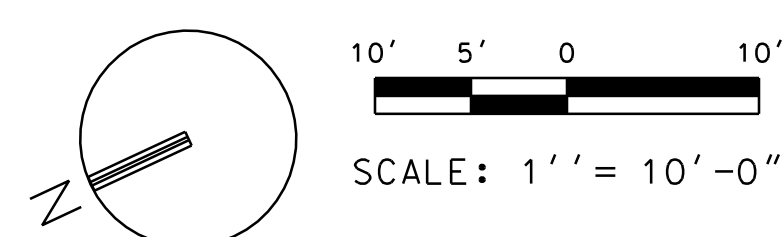


FORT SILL ARMY POST  
OKLAHOMA  
PDC: 65299  
CENTRAL ISSUE FACILITY  
(CIF)

**JOINTING PLAN**

|                                 |                     |                          |                              |
|---------------------------------|---------------------|--------------------------|------------------------------|
| PLOT SCALE:<br>AS SHOWN         | DWG. CODE:          | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFC-400.DGN | RFP NO.<br>W912BV-- | CONTRACT NO.<br>W912BV-- | <b>C400</b>                  |
| PLOT DATE:<br>XX - XXX - 2009   | SHEET<br>19 OF 41   |                          |                              |





NOTES:

1. NO CHANGE IN THE JOINTING PATTERN SHALL BE MADE WITHOUT WRITTEN APPROVAL OF THE CONTRACTING OFFICER.
2. SEE JOINT LAYOUT PLAN ON C400.

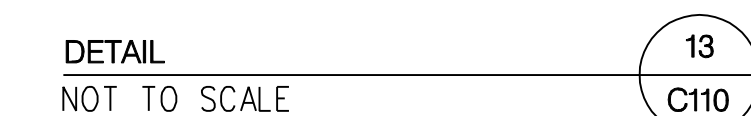
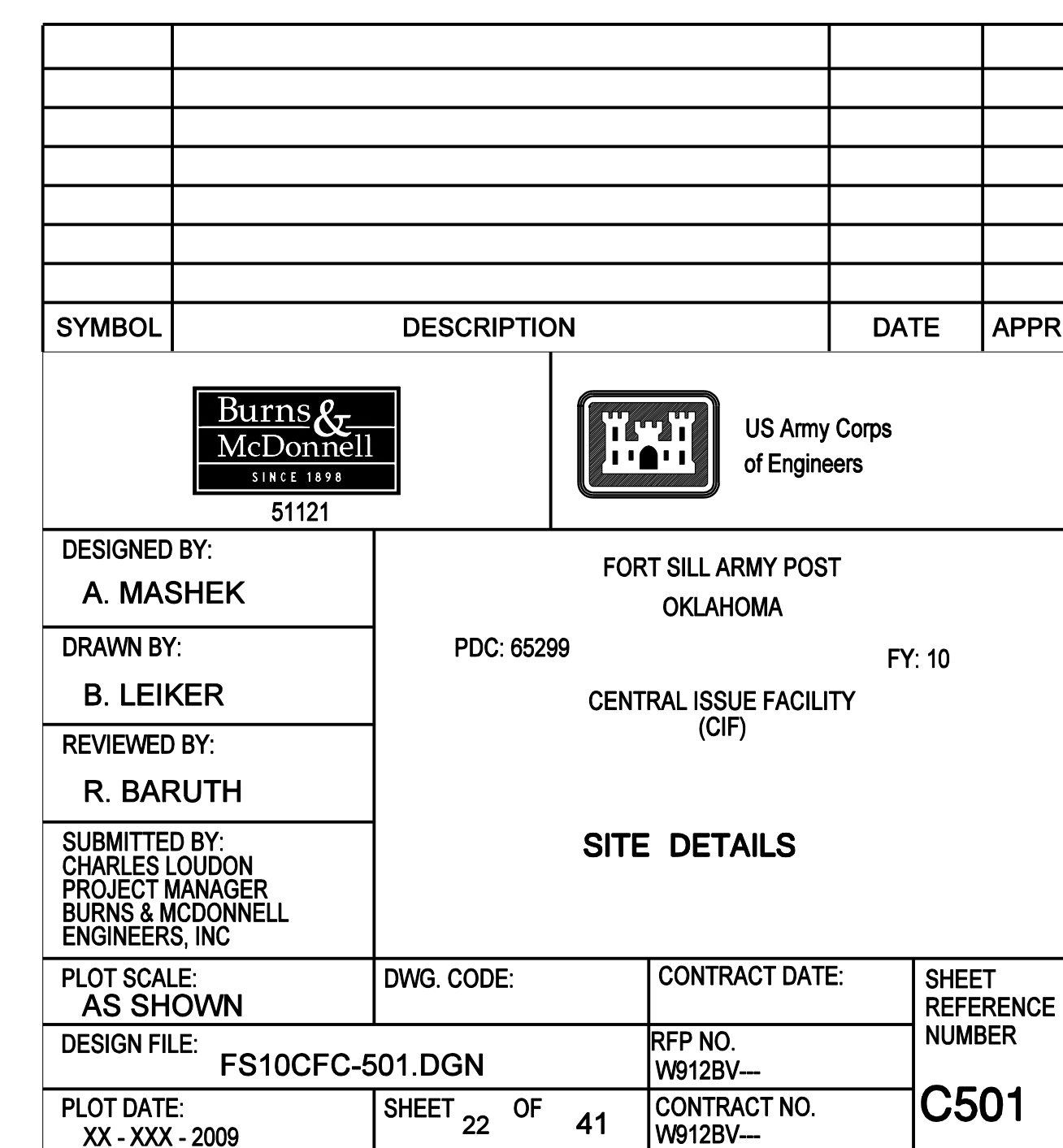
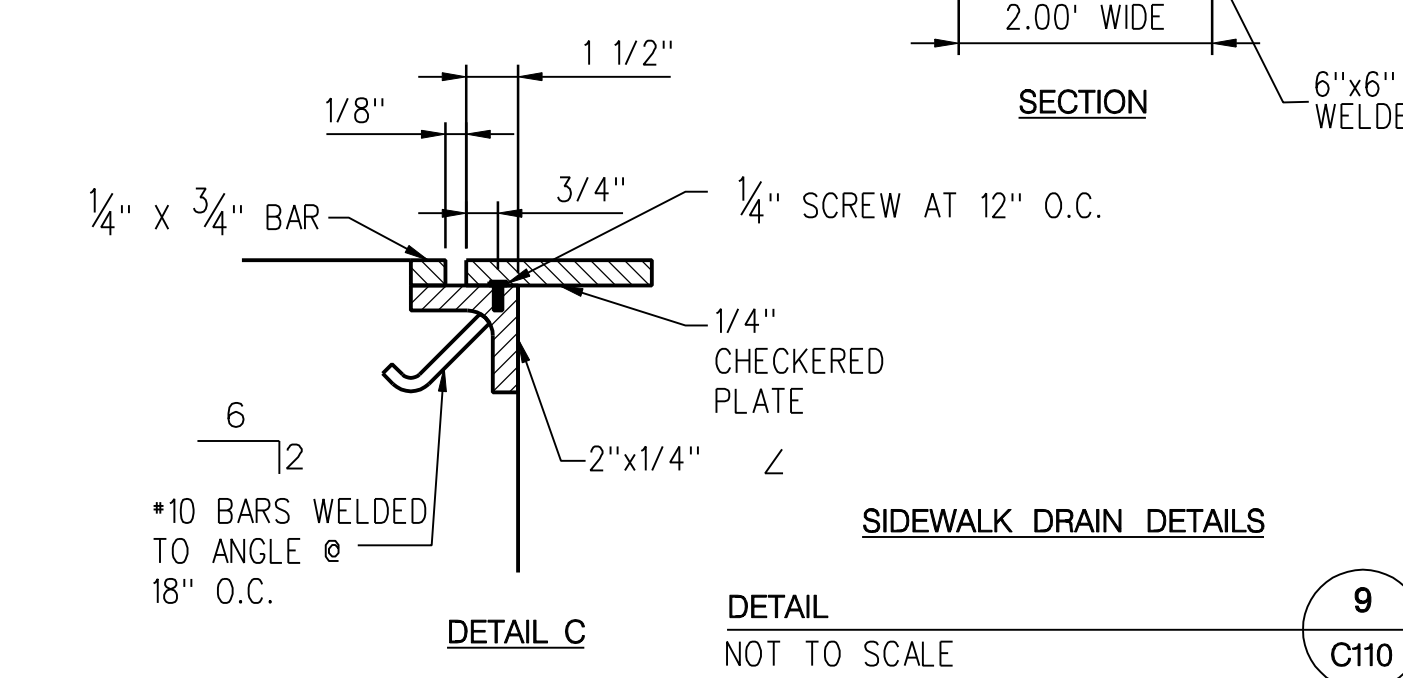
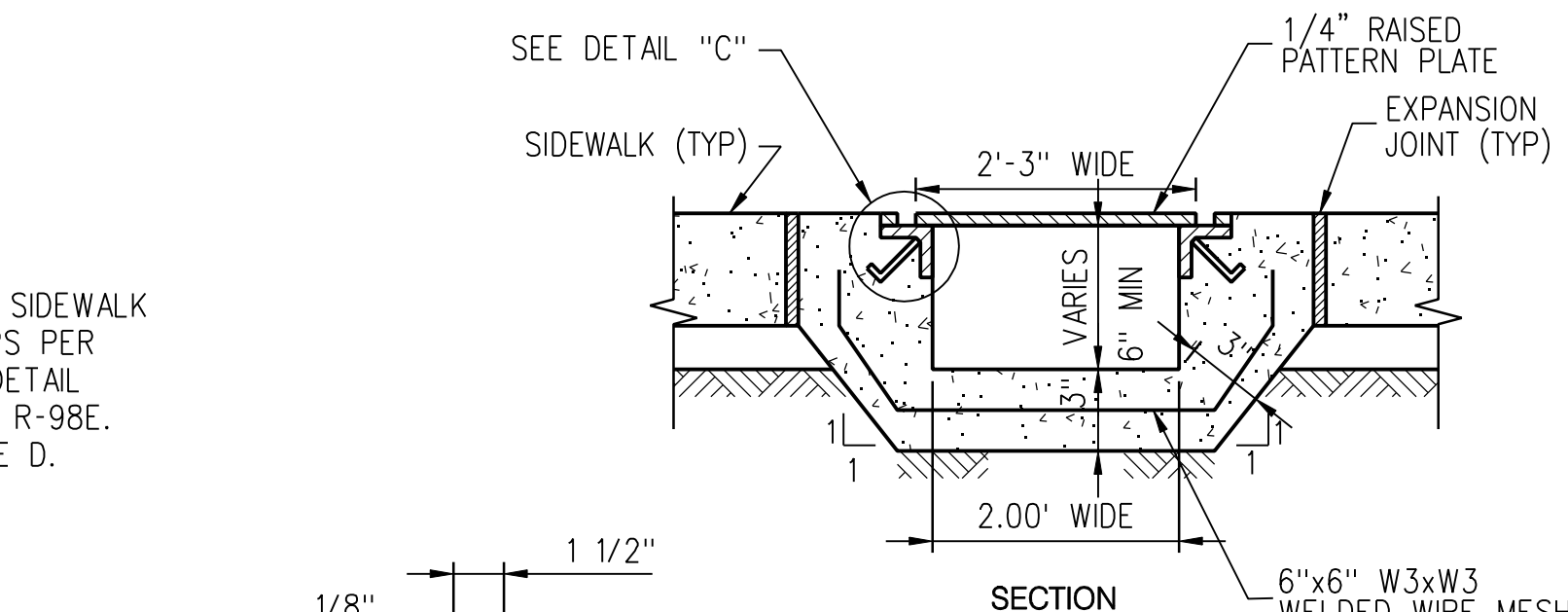
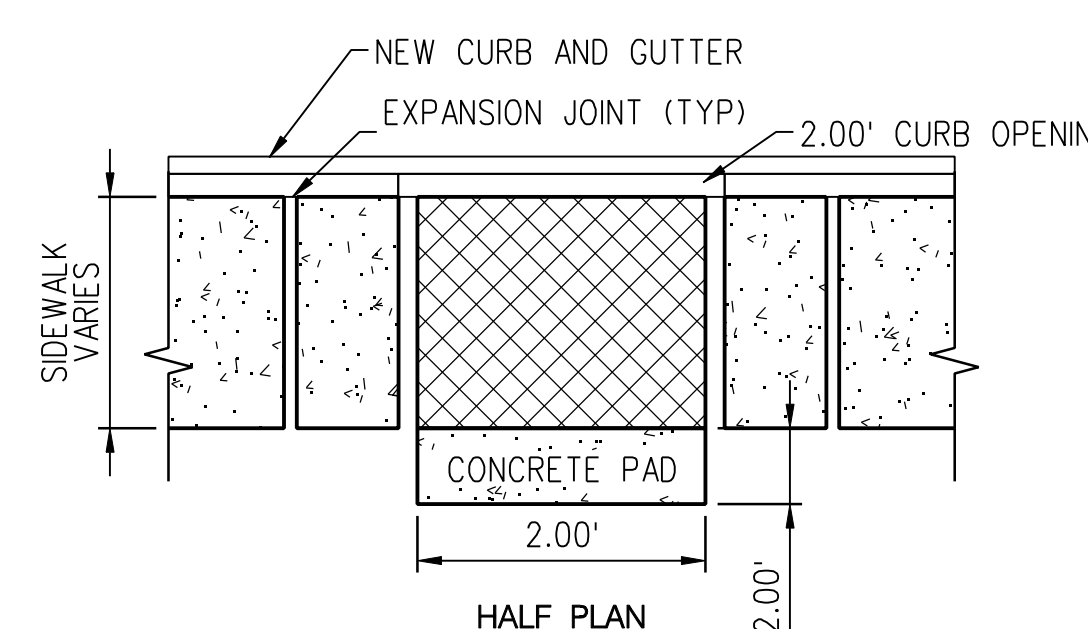
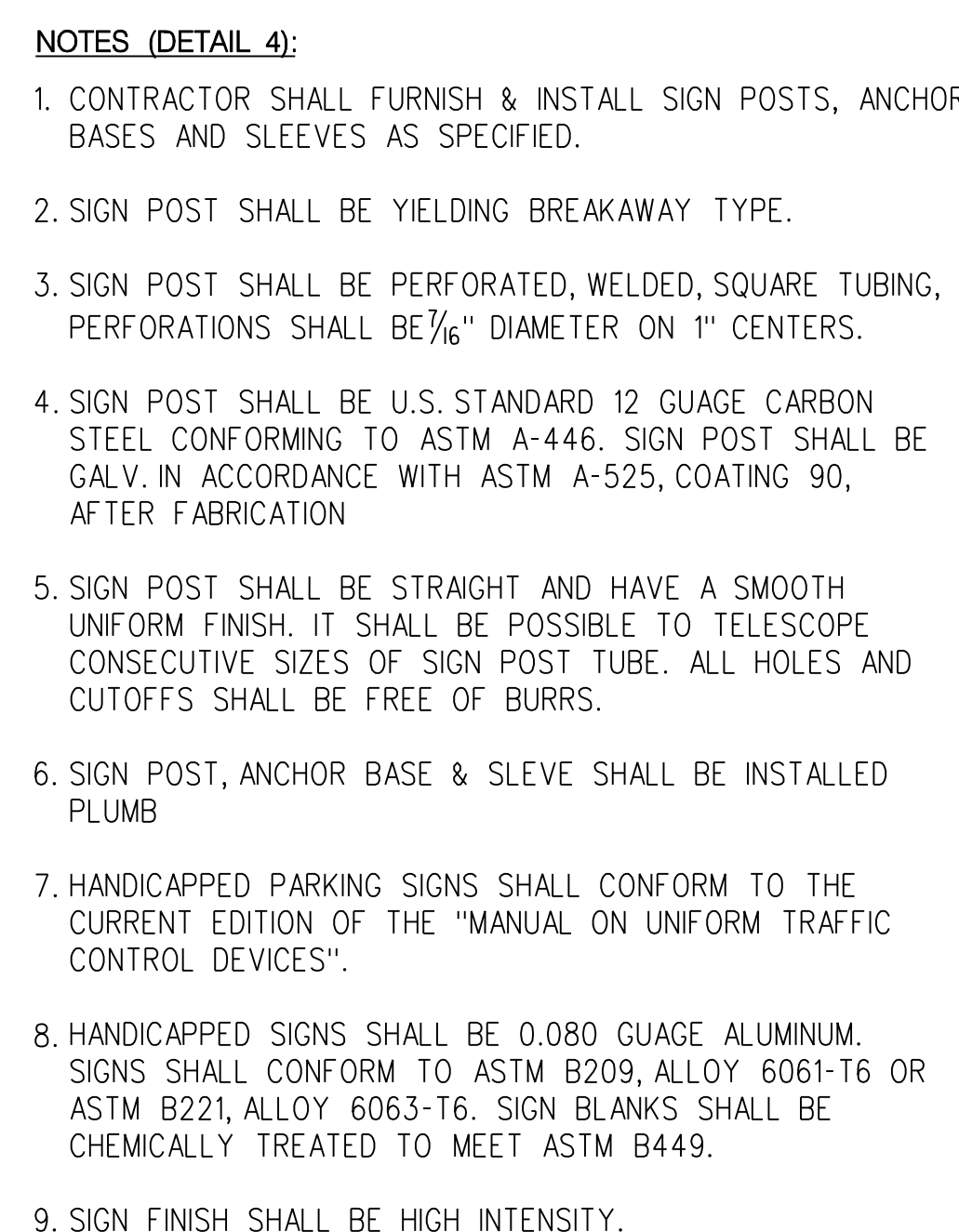
USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

[illegible]





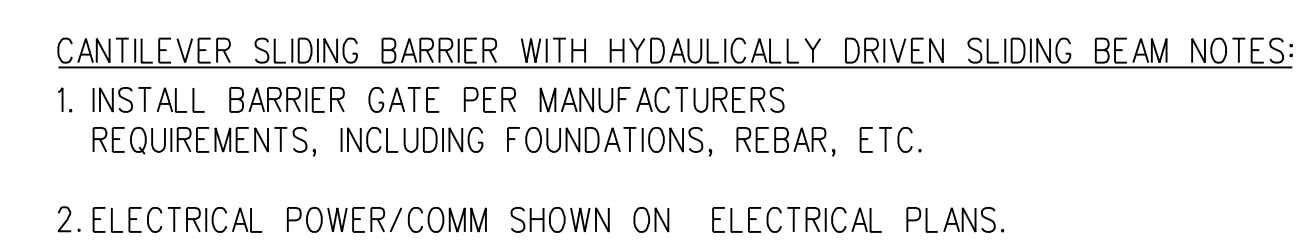
A









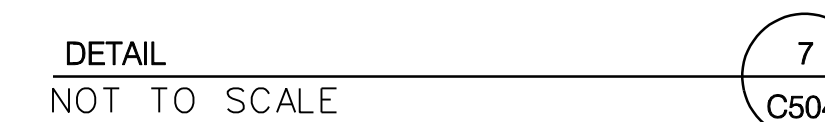
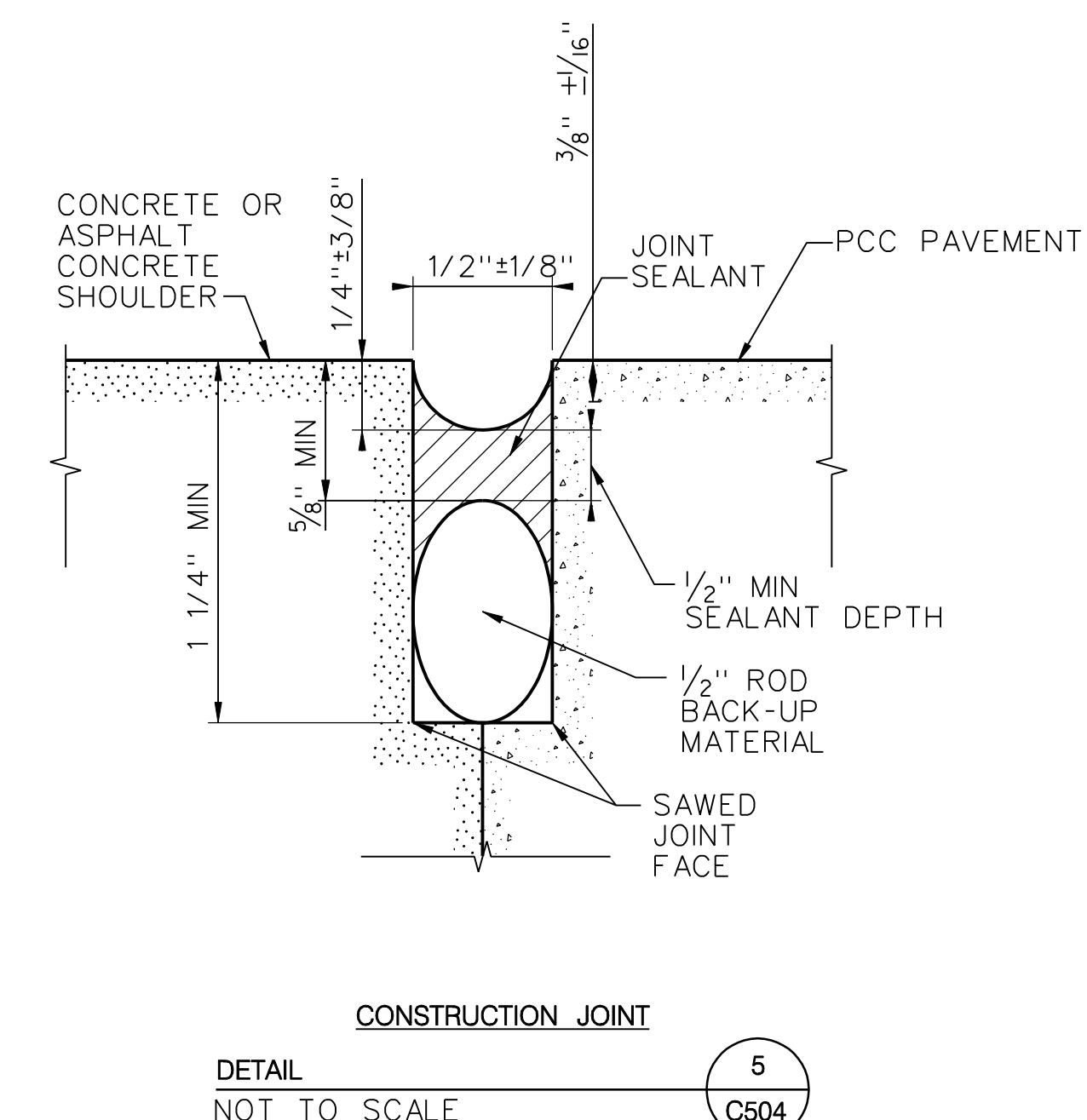


THRUST BLOCK DETAIL

DETAIL

NOT TO SCALE

1  
C504



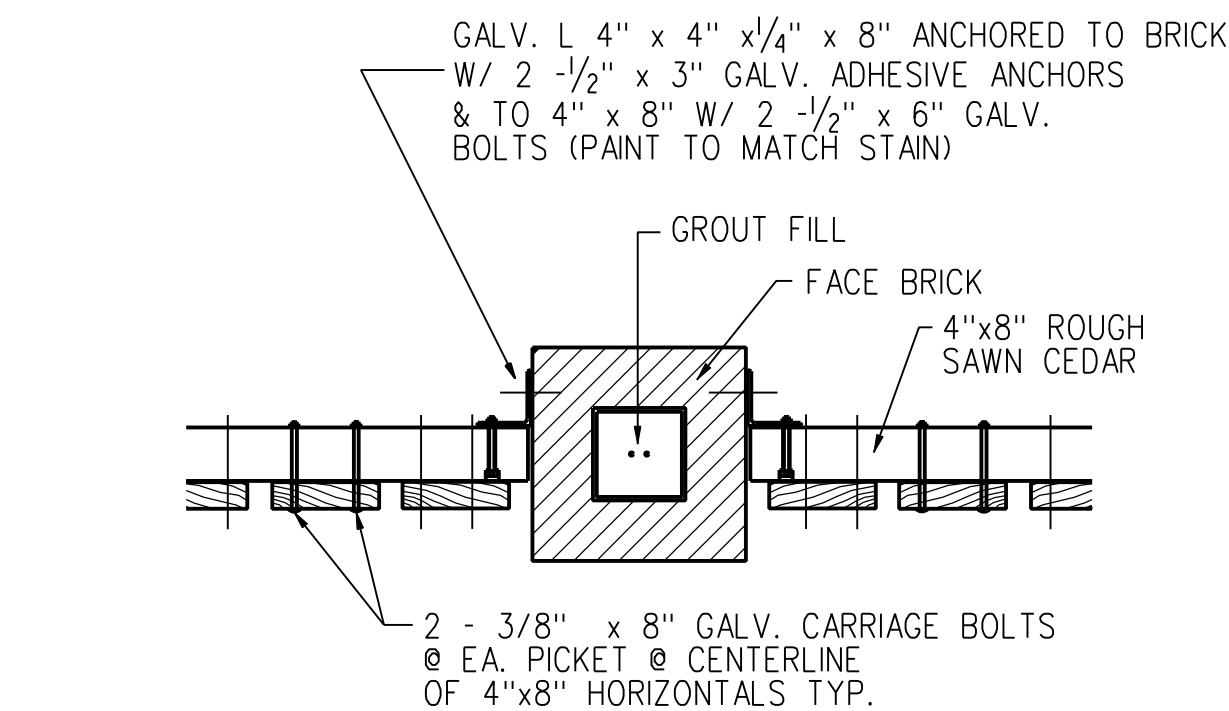
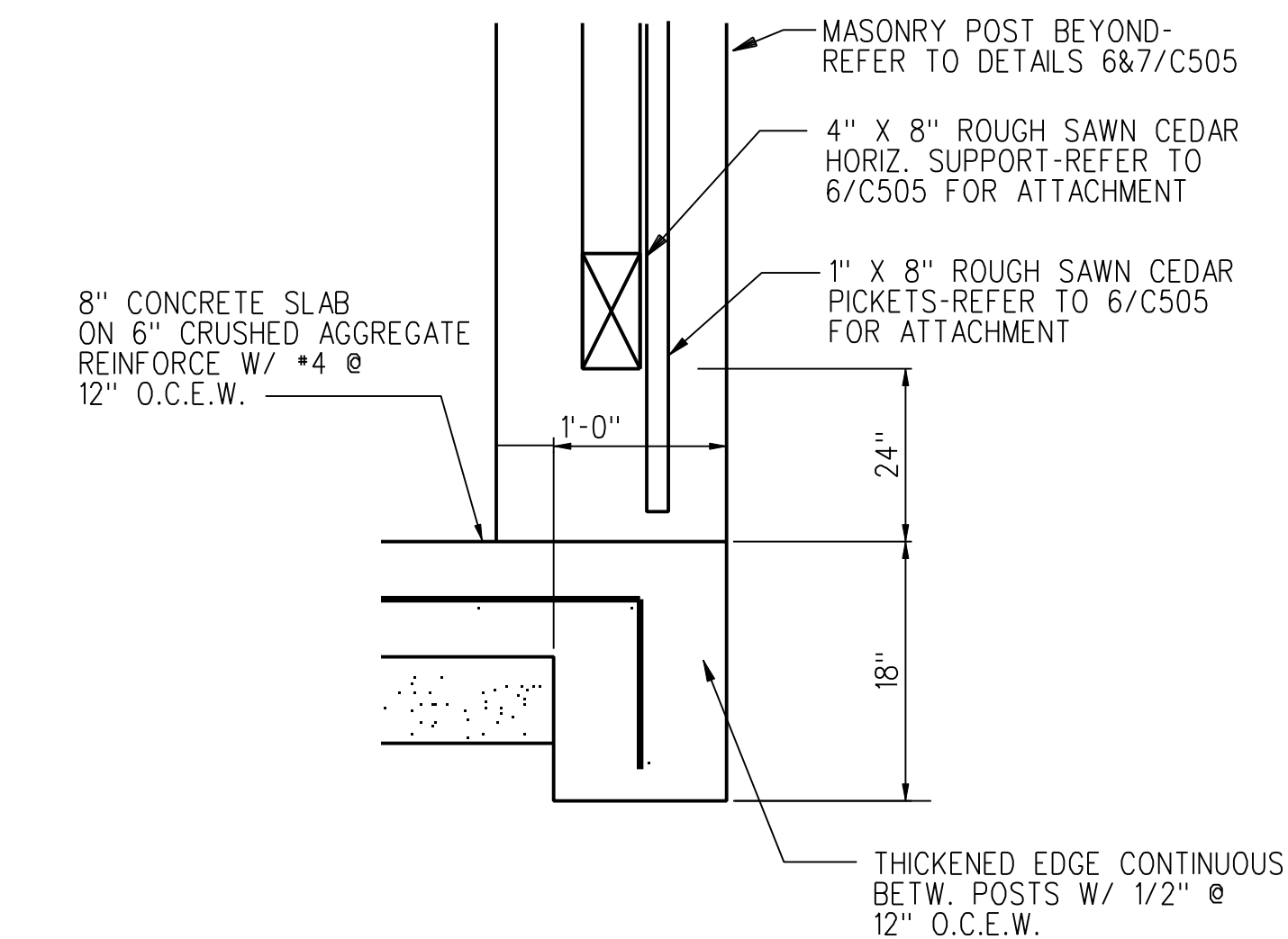
Friday, February 18, 2011

A

B

C

D



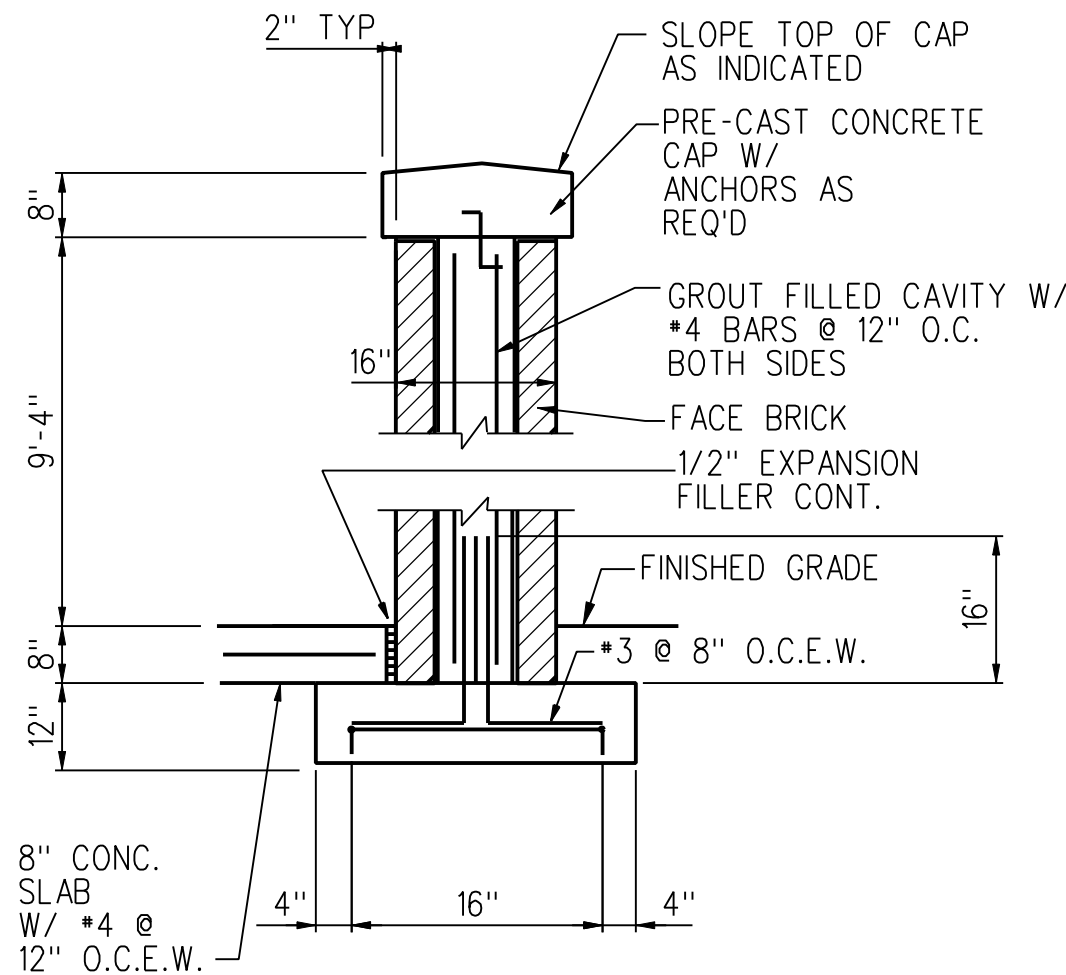
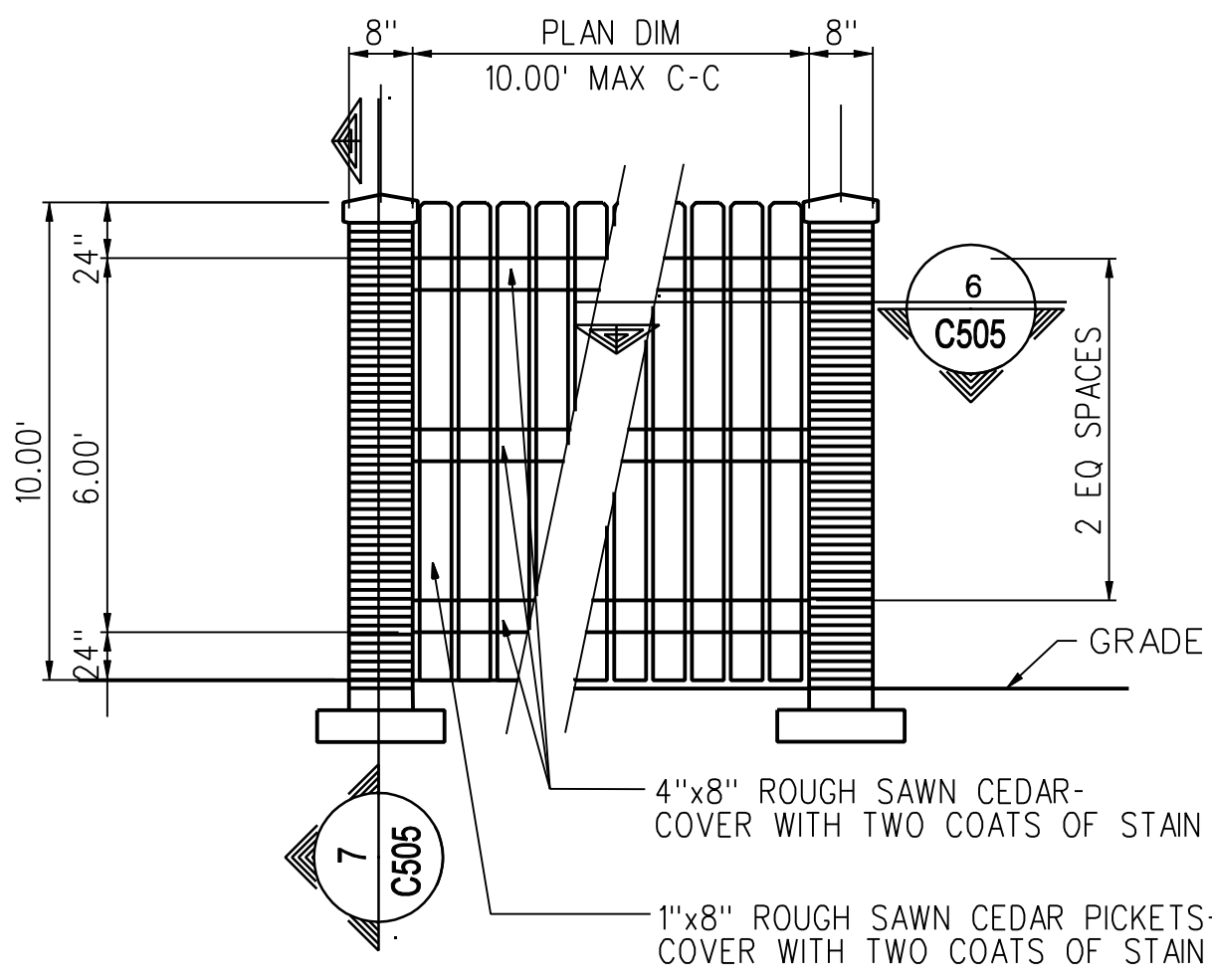
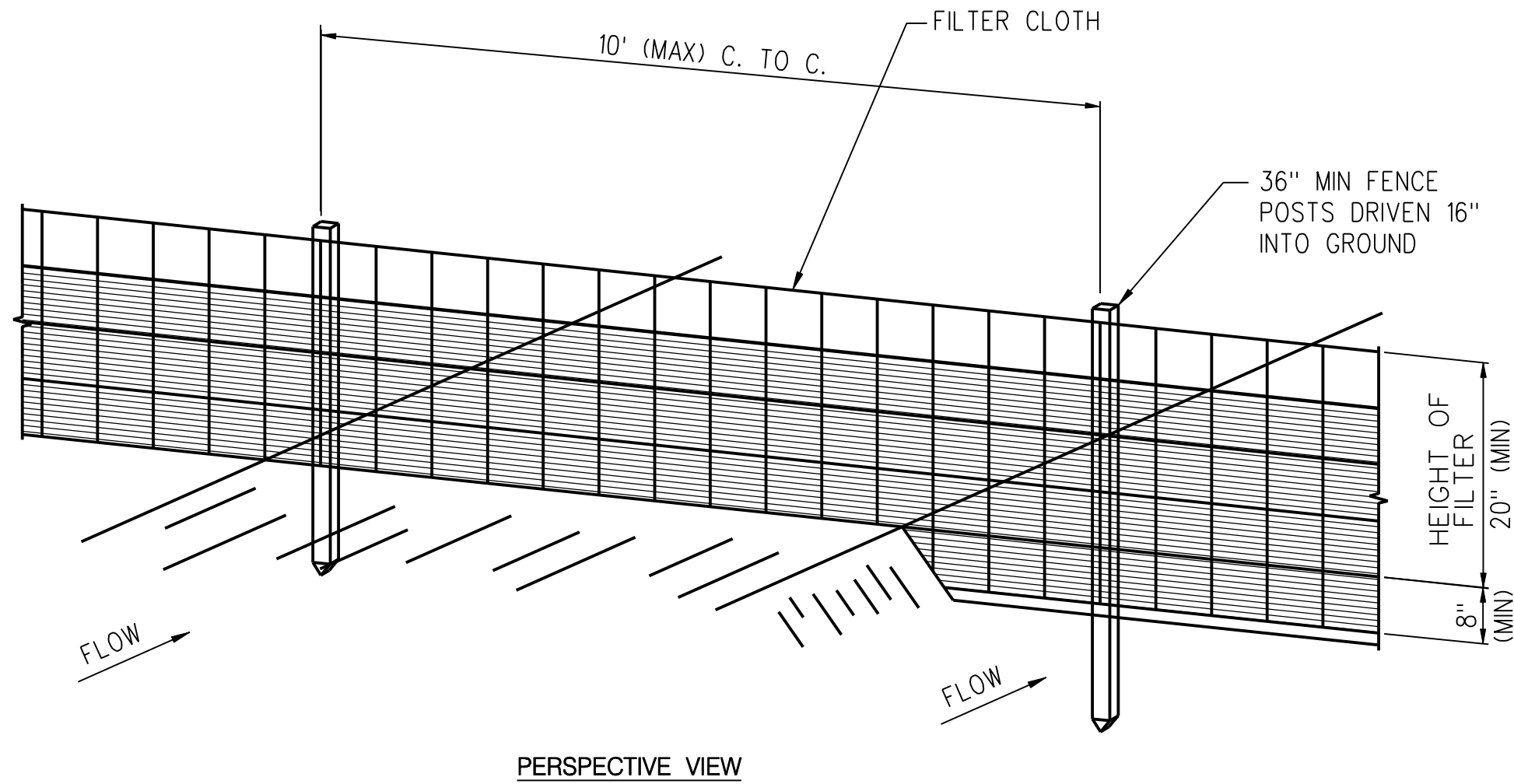
**CONSTRUCTION NOTES FOR FABRICATED SILT FENCE:**

1. ATTACH SILT FENCE TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER, THEY SHALL BE OVER- LAPPED BY 6" AND FOLDED.
3. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

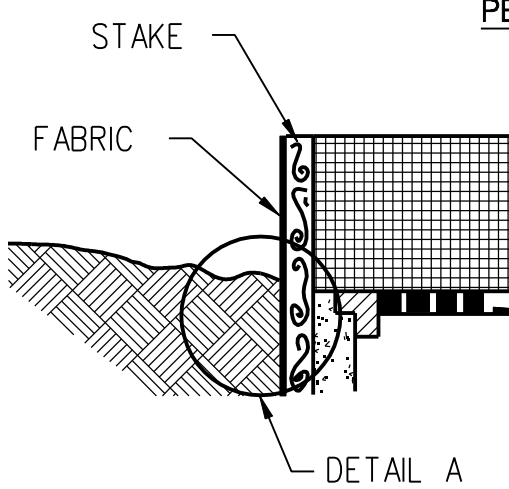
POSTS: STEEL EITHER "I" OR "U" TYPE OR 2" SQUARE HARDWOOD.

FILTER CLOTH: FILTER X, MIRAFI 100X, STABILINKA T140N OR APPROVED EQUAL.

PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR APPROVED EQUAL.



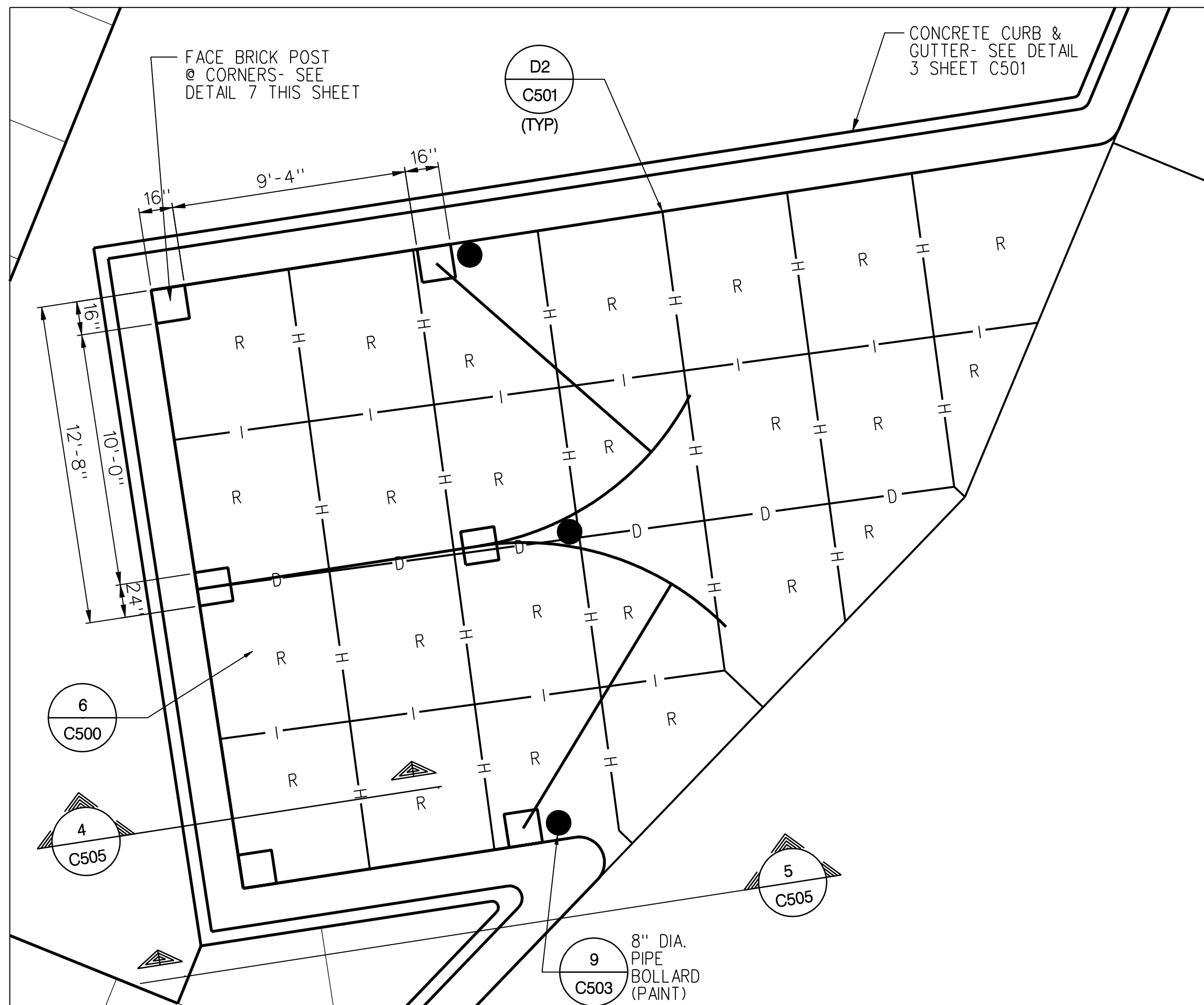
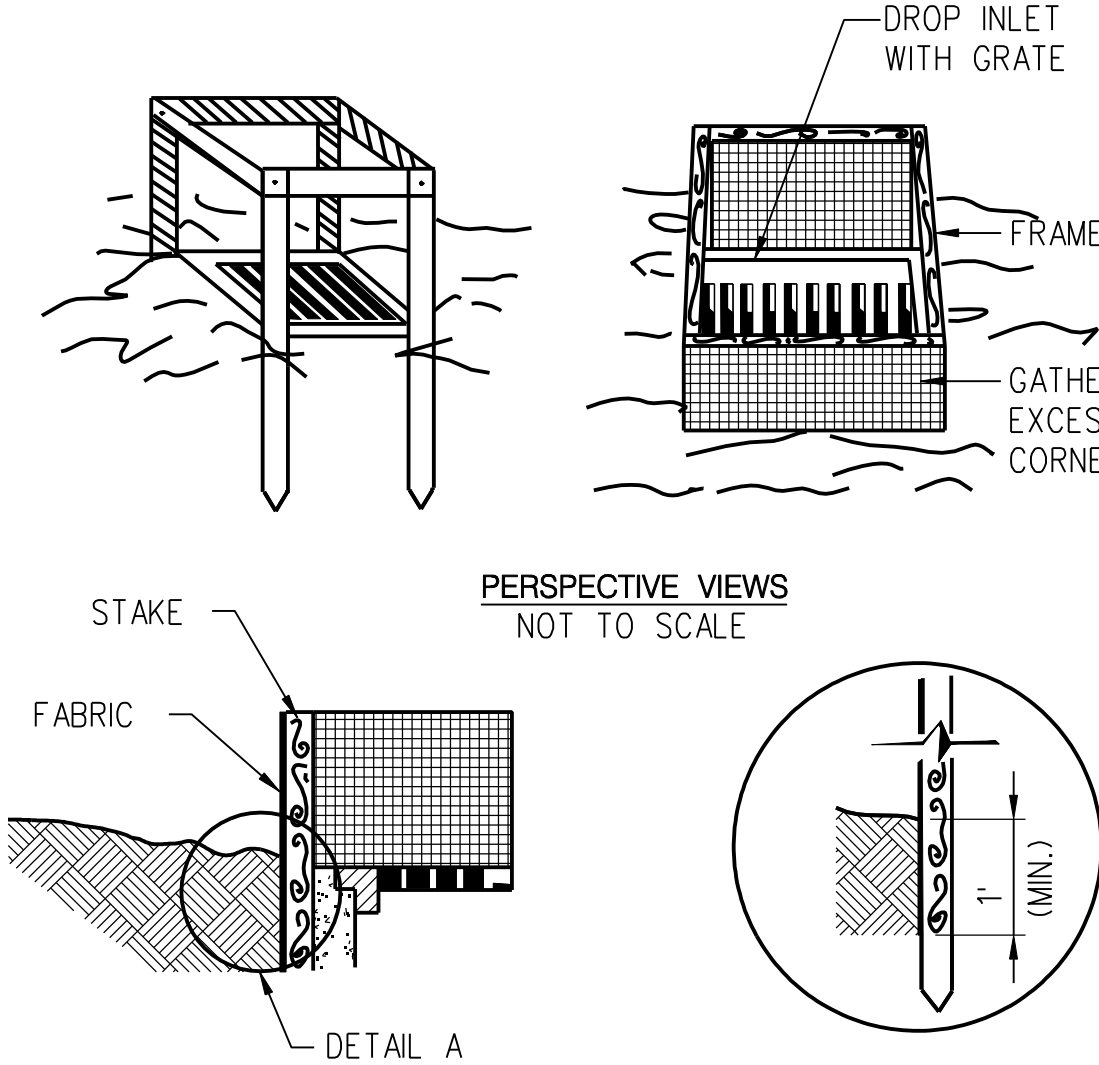
**ELEVATION OF STAKE AND FABRIC ORIENTATION**



**SEDIMENT FENCE DROP INLET PROTECTION**

**2**  
C505

**DETAIL**  
NOT TO SCALE



**8**  
C110  
C400

**DUMPSTER SCREEN PLAN**  
SECTION  
NOT TO SCALE

**SEDIMENT FENCE DROP INLET PROTECTION NOTES:**

**A) CONSTRUCTION SPECIFICATIONS:**

1. SEDIMENT FENCE SHALL CONFORM TO THE CONSTRUCTION SPECIFICATIONS FOR "EXTRA STRENGTH" FOUND IN THE TABLE BELOW AND SHALL BE CUT FROM A CONTINUOUS ROLL TO AVOID JOINTS.

**PHYSICAL PROPERTIES OF FILTER FABRIC IN SEDIMENT FENCE**

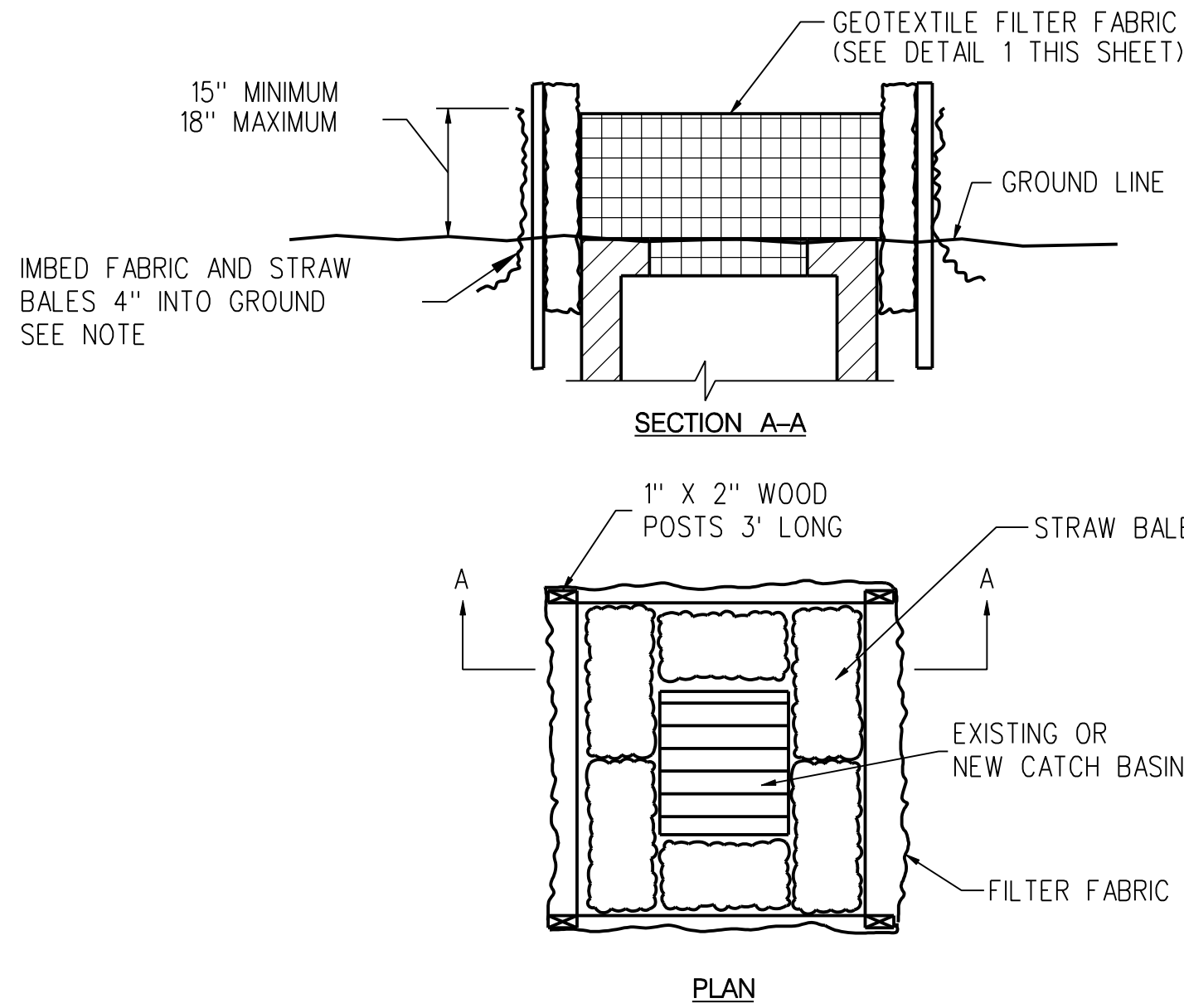
| PHYSICAL PROPERTY                          | TEST                        | REQUIREMENTS                                   |
|--|-----------------------------|--|
| FILTERING EFFICIENCY                       | ASTM 5141                   | 75% (MINIMUM)                                  |
| TENSILE STRENGTH AT 20% (MAX.) ELONGATION* | ASTM 4632<br>AASHTO M288-96 | EXTRA STRENGTH - 50 LBS./LINEAR INCH (MINIMUM) |
| FLOW RATE                                  | ASTM 5141                   | 0.2 GAL./SQ.FT./ MINUTE (MINIMUM)**            |
| ULTRAVIOLET RADIATION STABILITY %          | ASTM D 4355                 | 90% (MINIMUM)                                  |

- \* REQUIREMENT REDUCED BY 50% AFTER SIX MONTHS OF INSTALLATION
  - \*\* HIGH POROSITY FABRIC MAY BE BETTER SUITED FOR THIS DEVICE.
2. FOR STAKES, USE 2X4-INCH WOOD (PREFERRED) OR EQUIVALENT METAL WITH A MINIMUM LENGTH OF 3-FEET.
  3. SPACE STAKES EVENLY AROUND THE PERIMETER OF THE INLET A MAXIMUM OF 3-FEET APART, AND SECURELY DRIVE THEM INTO THE GROUND, APPROXIMATELY 18-INCHES DEEP.
  4. TO PROVIDE NEEDED STABILITY TO THE INSTALLATION, FRAME WITH 2X4-INCH WOOD STRIPS AROUND THE CREST OF THE OVERFLOW AREA AT A MAXIMUM OF 1 1/2 FEET ABOVE THE DROP INLET CREST.
  5. PLACE THE BOTTOM 12 INCHES OF THE FABRIC IN A TRENCH AND BACKFILL THE TRENCH WITH 12-INCHES OF COMPACTED SOIL.
  6. FASTEN FABRIC SECURELY BY STAPLES OR WIRE TO THE STAKES AND FRAME. JOINTS MUST BE OVERLAPPED TO THE NEXT STAKE.
  7. IT MAY BE NECESSARY TO BUILD A TEMPORARY DIKE ON THE DOWNSLOPE SIDE OF THE STRUCTURE TO PREVENT BYPASS FLOW.

**B) INSPECTION AND MAINTENANCE:**

1. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NEEDED.
2. SEDIMENT SHALL BE REMOVED AND THE TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE HALF THE DESIGN DEPTH OF THE TRAP. REMOVED SEDIMENT SHALL BE DEPOSITED IN A SUITABLE AREA AND IN SUCH A MANNER THAT IT WILL NOT ERODE.
3. STRUCTURES SHALL BE REMOVED AND THE AREA STABILIZED WHEN THE REMAINING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

**NOTE:**  
SEE JOINT LAYOUT PLAN ON SHEET C400.





**NOTE:**  
STRAW BALES SHALL BE PLACED AROUND INLET GRATE. BALES SHALL BE IMBEDDED 4" INTO GROUND AND SECURELY STAKED IN PLACE.

**STRAW BALE INLET PROTECTION**

**3**  
C505

**SECTION**  
NOT TO SCALE

|  |  |                     |  |   |  |                              |  |
|--|--|---------------------|--|---|--|------------------------------|--|
|       |  |                     |  |  |  |                              |  |
| DESIGNED BY:<br><b>A. MASHEK</b>   |  |                     |  | FORT SILL ARMY POST<br>OKLAHOMA   |  |                              |  |
| DRAWN BY:<br><b>B. LEIKER</b>  |  |                     |  | PDC: 65299  |  |                              |  |
| REVIEWED BY:<br><b>R. BARUTH</b>   |  |                     |  | CENTRAL ISSUE FACILITY<br>(CIF)   |  |                              |  |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |  |                     |  | MISCELLANEOUS DETAILS<br>(3 OF 3)   |  |                              |  |
| PLOT SCALE:<br>AS SHOWN  |  | DWG. CODE:          |  | CONTRACT DATE:  |  | SHEET<br>REFERENCE<br>NUMBER |  |
| DESIGN FILE:<br>FS10CFC-505.DGN  |  | RFP NO.<br>W912BV-- |  | CONTRACT NO.<br>W912BV--  |  | <b>C505</b>                  |  |
| PLOT DATE:<br>XX - XXX - 2009  |  | SHEET<br>26 OF 41   |  | CONTRACT NO.<br>W912BV--  |  |                              |  |







D

C

B

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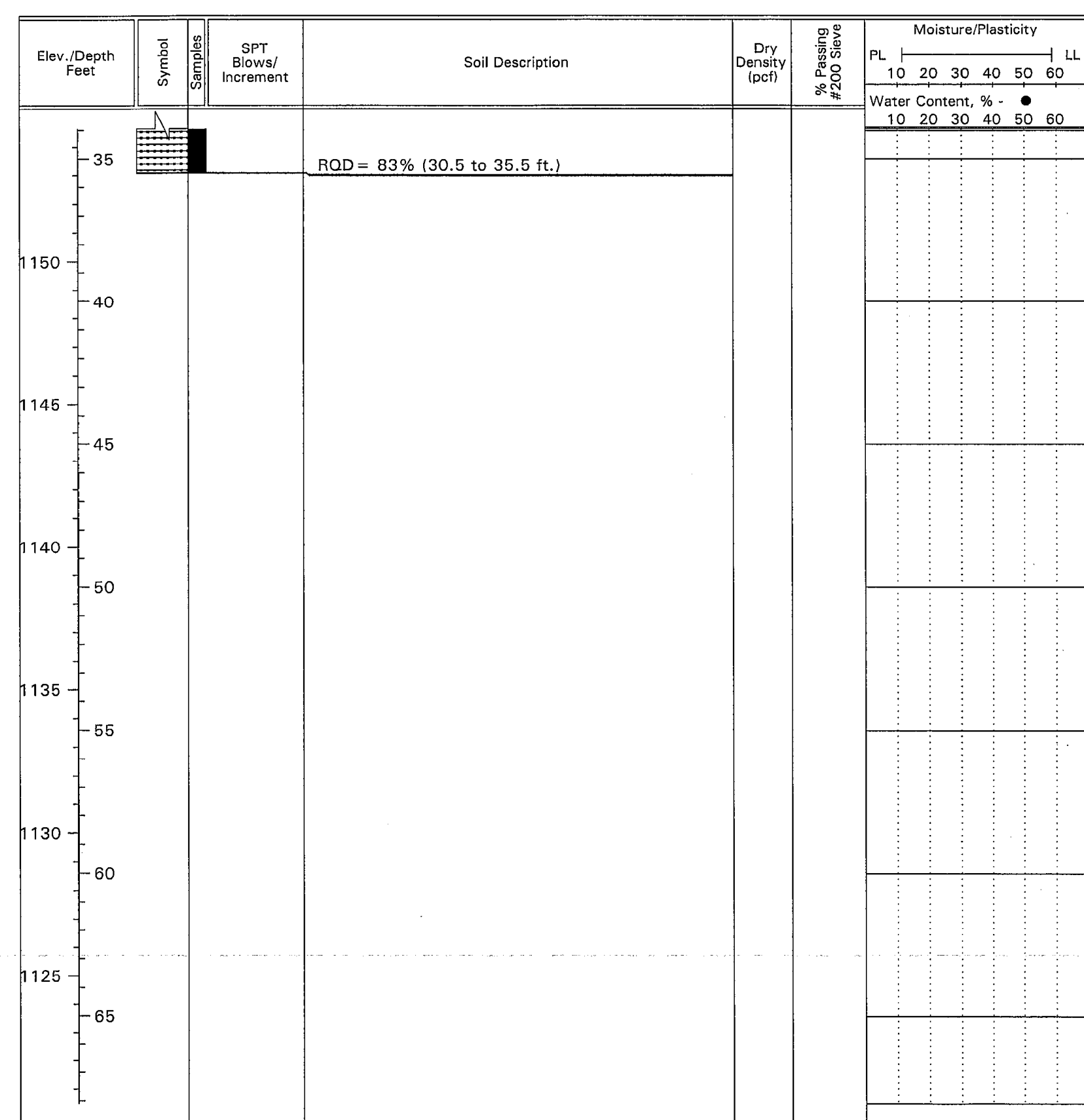
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GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-6 continued  
Project No.: 7309-3055  
Date Drilled.: 02/17/09 - 02/18/09



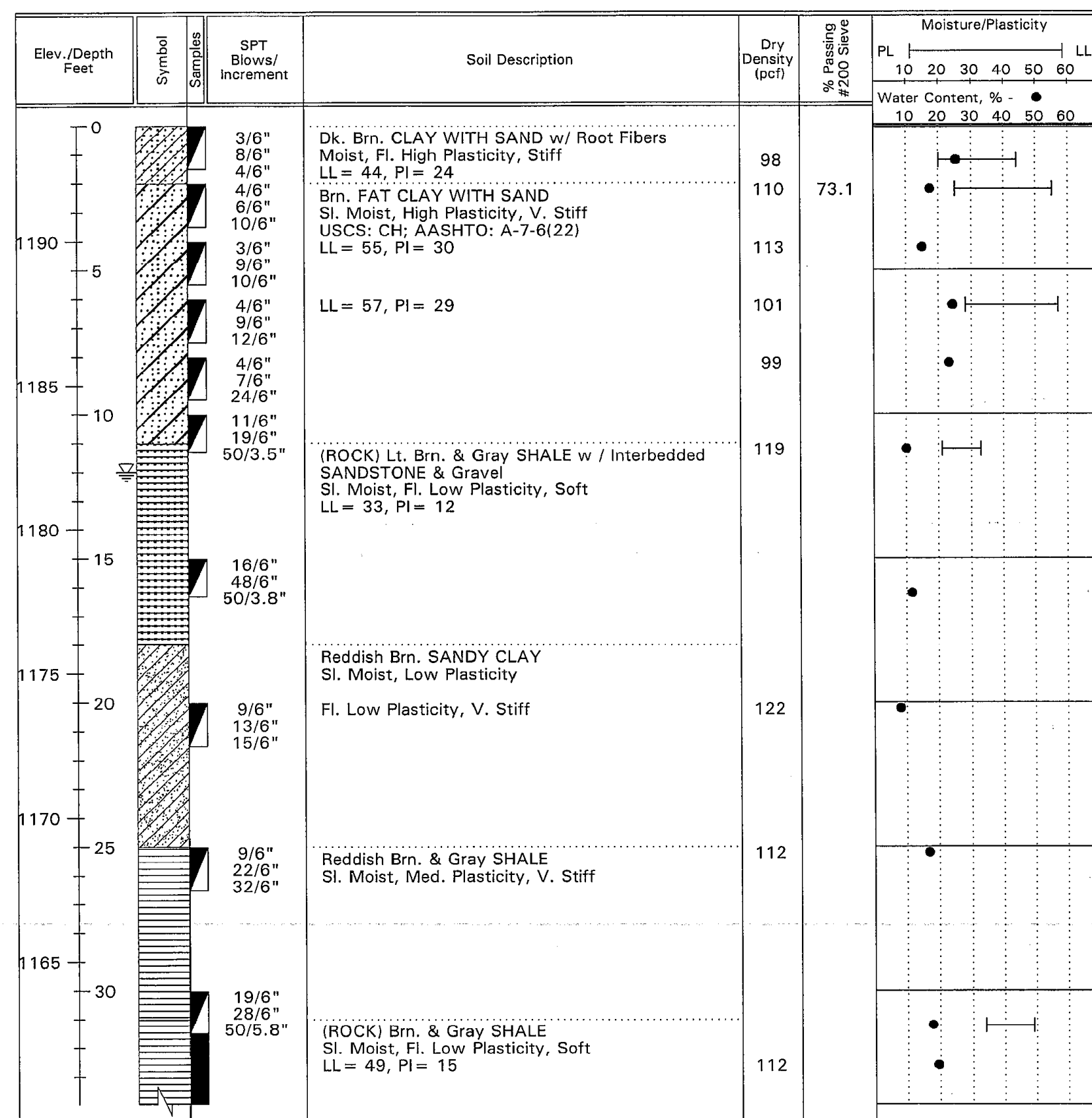
Page: 2 of 2 for boring BH-6



GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-7  
Project No.: 7309-3055  
Date Drilled.: 02/13/09 & 2/16/09  
Project Engineer: Vajra Rai & J. Pan  
Drill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSA  
Field Logger: Johnny Jarman  
Surface Elevation: 1194.0 ft.  
Water Depth: 12 ft. after 24 hrs.  
Remarks: Surface elevation provided by client



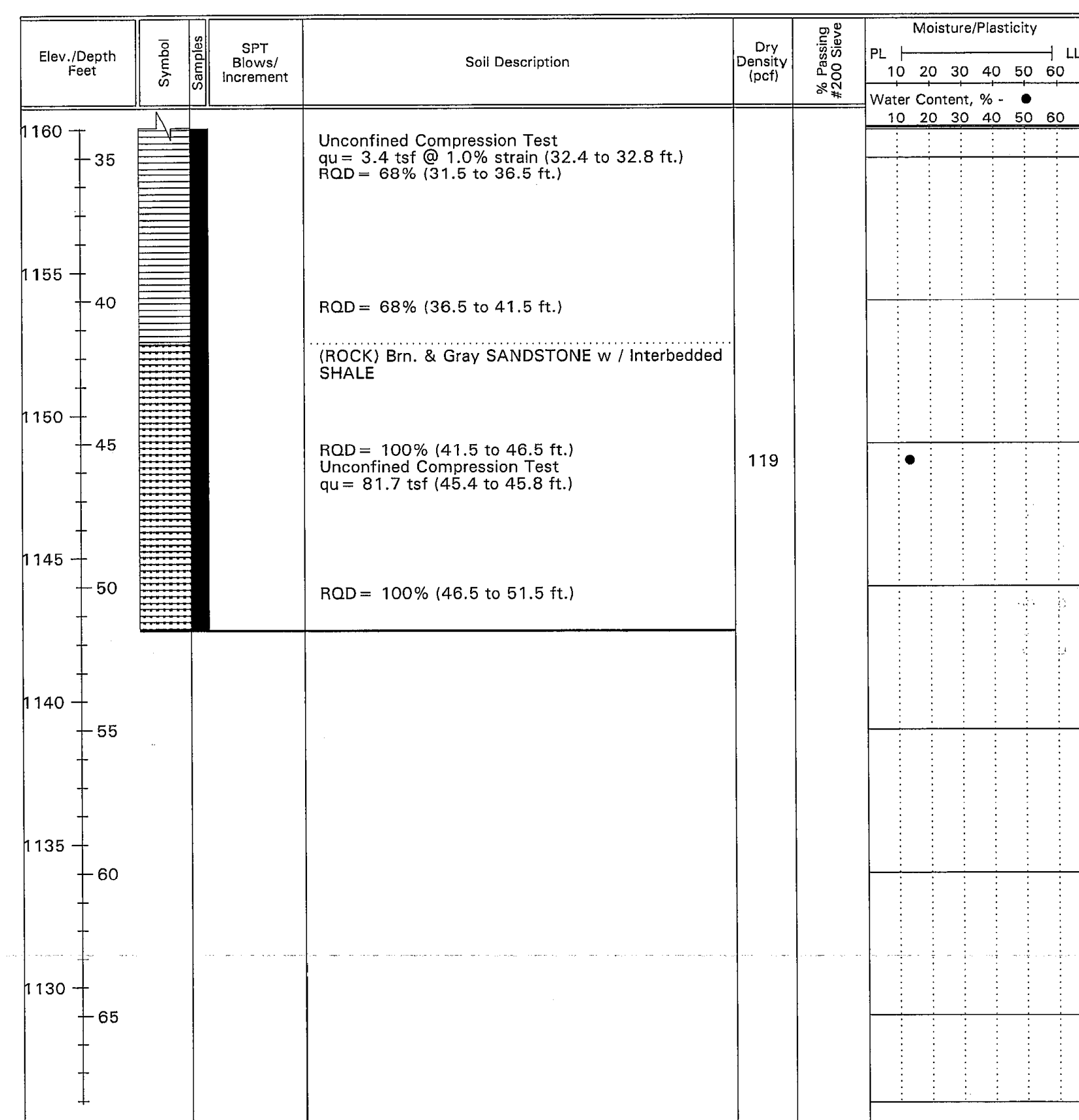
Page: 1 of 2 for boring BH-7



GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-7 continued  
Project No.: 7309-3055  
Date Drilled.: 02/13/09 & 2/16/09



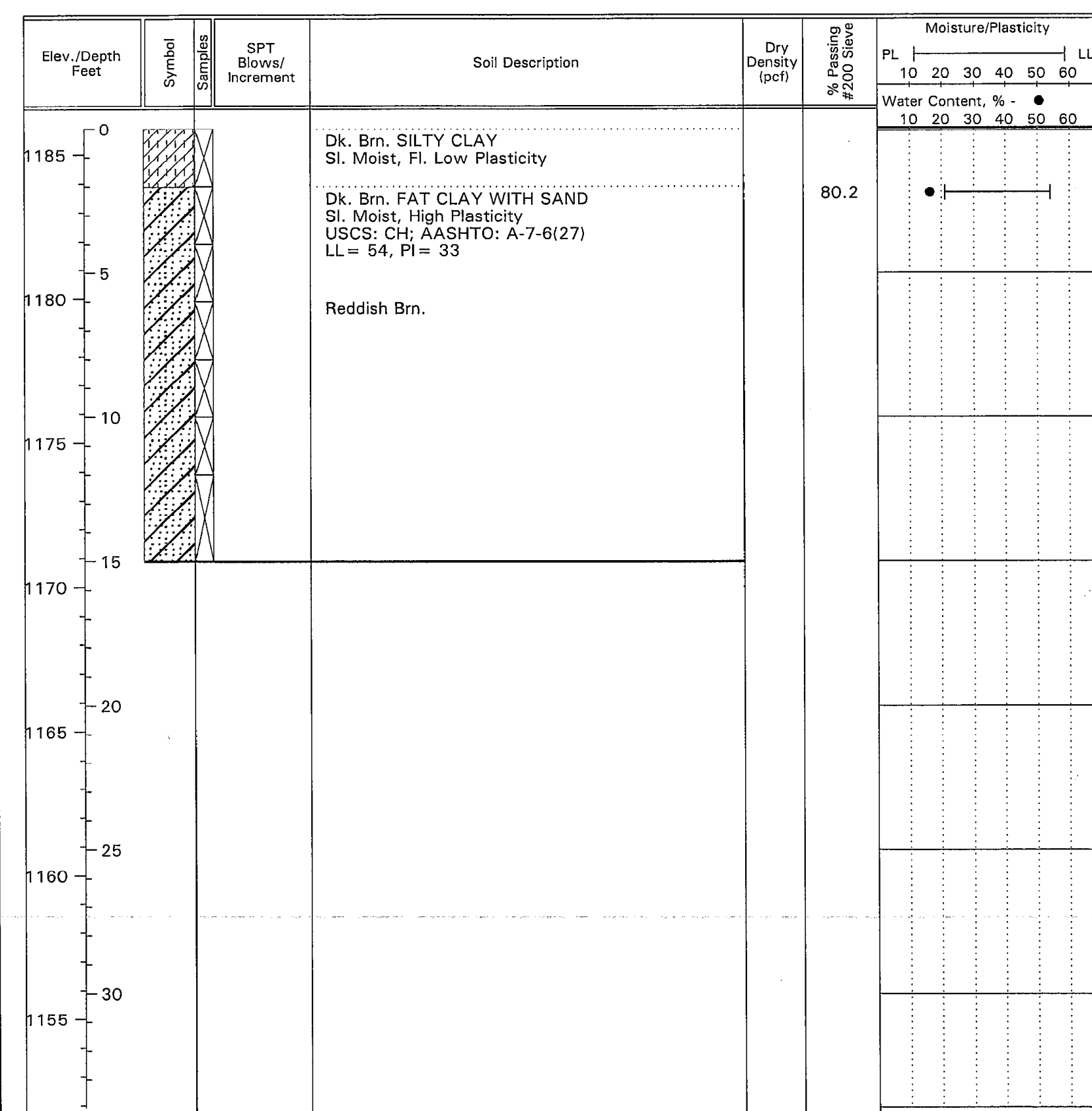
Page: 2 of 2 for boring BH-7



GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-8  
Project No.: 7309-3055  
Date Drilled.: 01/28/09  
Project Engineer: Vajra Rai & J. Pan  
Drill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSA  
Field Logger: Johnny Jarman  
Surface Elevation: 1185.9 ft.  
Water Depth: Dry @ Completion  
Remarks: Surface elevation provided by the client



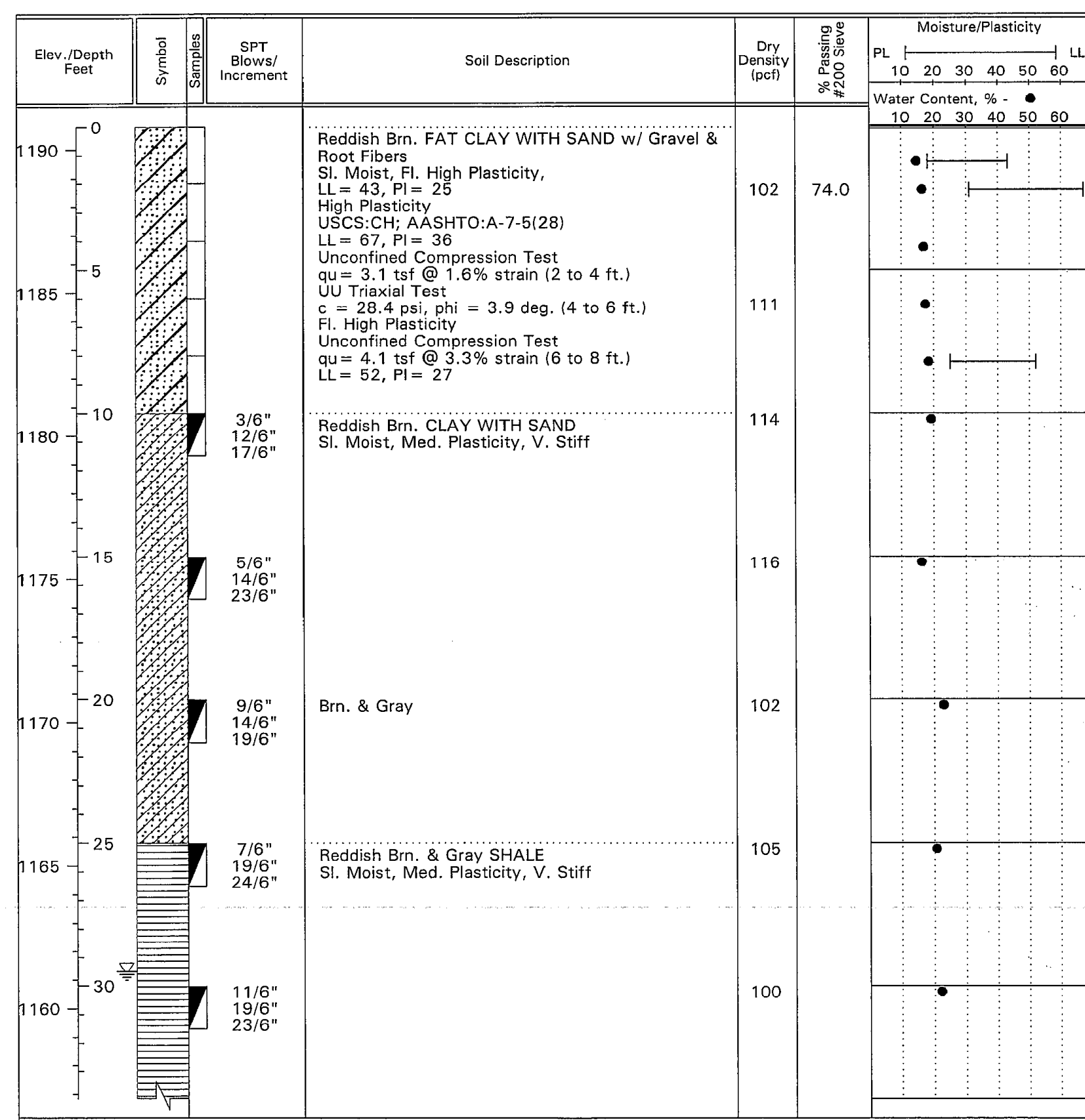
Page: 1 of 1 for boring BH-8



GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-9  
Project No.: 7309-3055  
Date Drilled.: 02/16/09 - 02/17/09  
Project Engineer: Vajra Rai & J. Pan  
Drill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSA  
Field Logger: Johnny Jarman  
Surface Elevation: 1190.8 ft.  
Water Depth: 29.5 ft. after 24 hrs.  
Remarks: Surface elevation provided by client



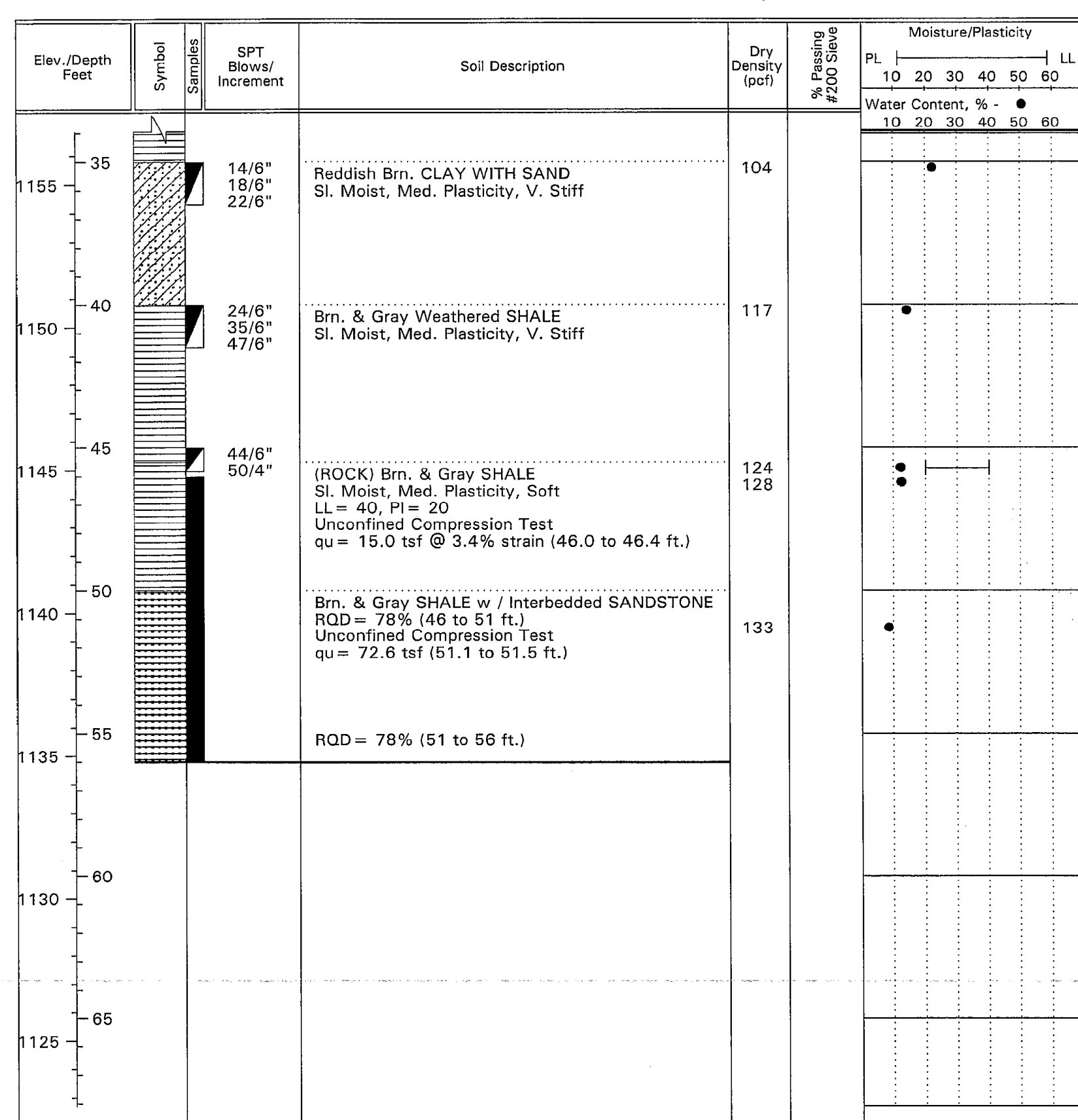
Page: 1 of 2 for boring BH-9



GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-9 continued  
Project No.: 7309-3055  
Date Drilled.: 02/16/09 - 02/17/09



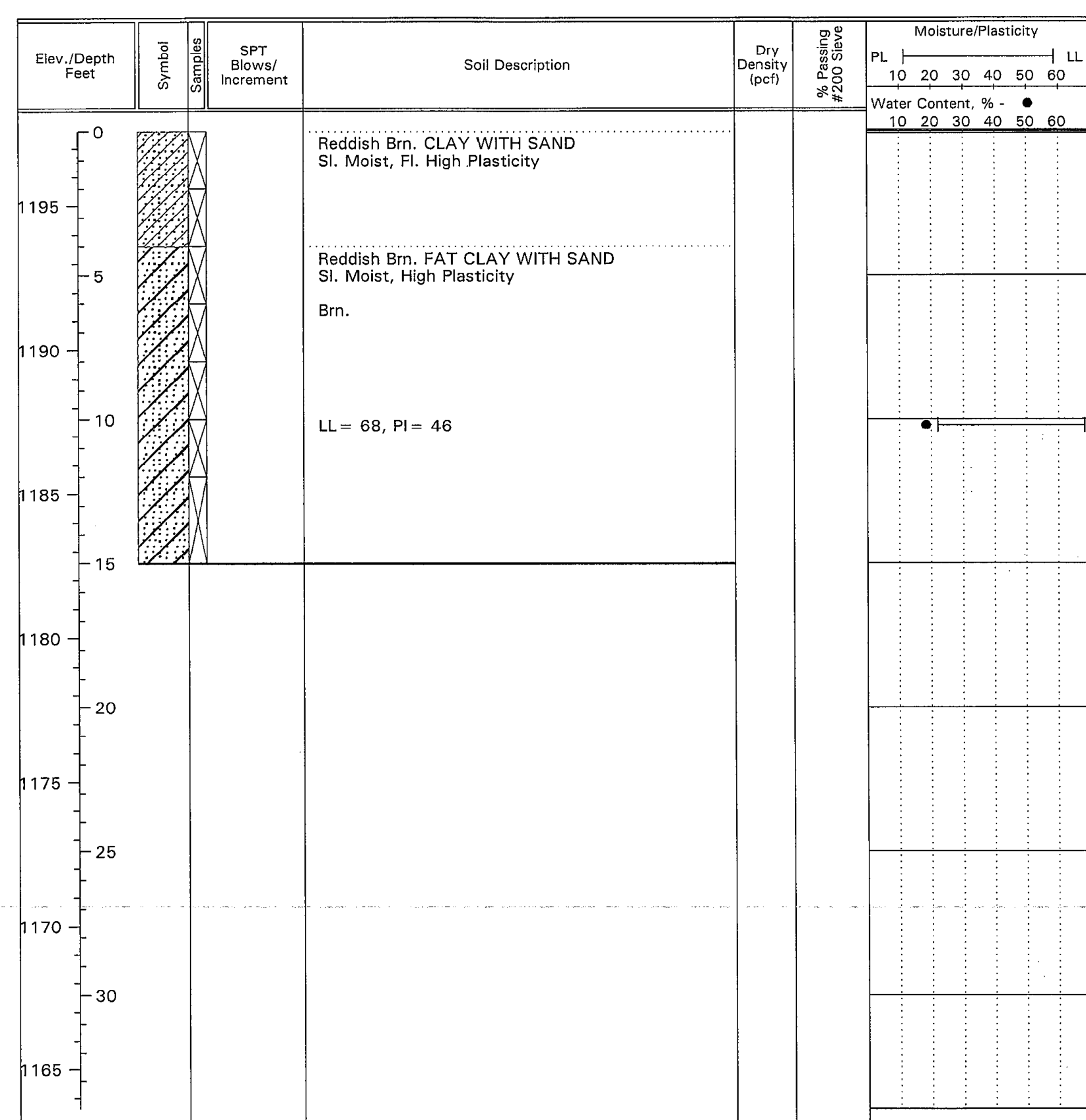
Page: 2 of 2 for boring BH-9





GEOTECHNICAL SERVICES

### SOIL BORING LOG

Project: Central Issue Facility  
Project Location: Randolph Rd. & Currie Rd., Ft. Sill, Oklahoma  
Boring No. BH-10  
Project No.: 7309-3055  
Date Drilled.: 01/28/09  
Project Engineer: Vajra Rai & J. Pan  
Drill Method: CME - 55 w / 3.25" I.D. - 7.25" O.D. HSA  
Field Logger: Johnny Jarman  
Surface Elevation: 1197.6 ft.  
Water Depth: Dry @ Completion  
Remarks: Surface elevation provided by the client



Page: 1 of 1 for boring BH-10

| SYMBOL   | DESCRIPTION                     | DATE                     | APPR                         |
|--|---------------------------------|--------------------------|------------------------------|
|  51121                      |                                 |                          |                              |
|  US Army Corps of Engineers |                                 |                          |                              |
| DESIGNED BY:<br>A. MASHEK  | FORT SILL ARMY POST<br>OKLAHOMA |                          |                              |
| DRAWN BY:<br>B. LEIKER   | PDC: 65299 FY: 10               |                          |                              |
| REVIEWED BY:<br>R. BARUTH  | CENTRAL ISSUE FACILITY<br>(CIF) |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC.                       | BORING LOG<br>(2 OF 2)          |                          |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:                      | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFC-507.DGN  |                                 | RFP NO.<br>W912BV--      |                              |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>28 OF 41               | CONTRACT NO.<br>W912BV-- | C507                         |

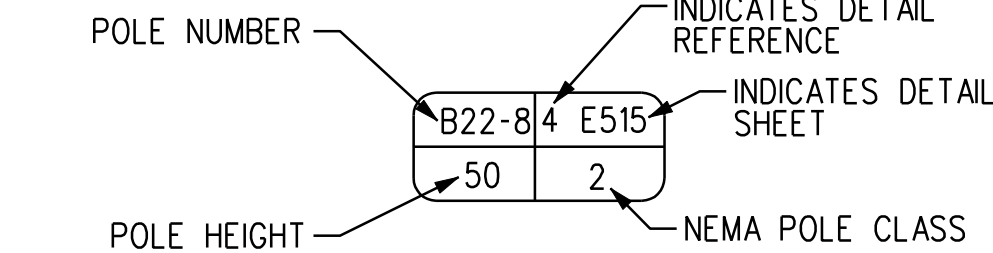


A

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WORK BY THIS PROJECT  
WORK BY DESCRIBED BY SECTION 0110 00 OR EXISTING

PEDE6 ABOVE GROUND TELECOMMUNICATION "PED 6" IS IDENTIFIER OF PEDESTAL WITHOUT IDENTIFYING THE SPECIFIC CABLE IN THE PEDESTAL.

MH MANHOLE ("E" DENOTES POWER, "C" DENOTES COMMUNICATIONS) ("MH" DENOTES MANHOLE).

PAID MOUNTED SWITCH

THREE SINGLE PHASE POLE-MOUNTED TRANSFORMER

SINGLE PHASE POLE-MOUNTED TRANSFORMER

POLE TO BE REMOVED

EXISTING POLE TO BE REPLACED WITH NEW POLE

NEW POLE

POWER POLE, EXISTING TO REMAIN

PAD MOUNTED TRANSFORMER

TWO ANCHORS WITH DOWN GUYS

SINGLE ANCHOR WITH DOWN GUYS

POLE MOUNTED LUMINAIRE, TYPE, CIRCUIT. SEE FIXTURE SCHEDULE ON THIS SHEET.

3-75 SINGLE PHASE POLE MOUNTED TRANSFORMER QUANTITY(3) SINGLE PHASE TRANSFORMERS

35-3 WOOD POLE CLASS (ANSI)  
LENGTH OF POLE

4-5B3 POLE NUMBER  
PRIMARY CIRCUIT NUMBER

BOLD HATCHING OVER UNDERGROUND UTILITY INDICATES DEMOLITION BY THIS CONTRACT

C(SD) EXISTING UNDERGROUND COMMUNICATIONS DIRECT BURIED OSP CABLE WITH A NEW 4" SPLIT DUCT AROUND CABLE. CONCRETE ENCASED.

C(DB) EXISTING UNDERGROUND COMMUNICATIONS DIRECT BURIED OSP CABLE. SIZE INDICATED ON PLANS.

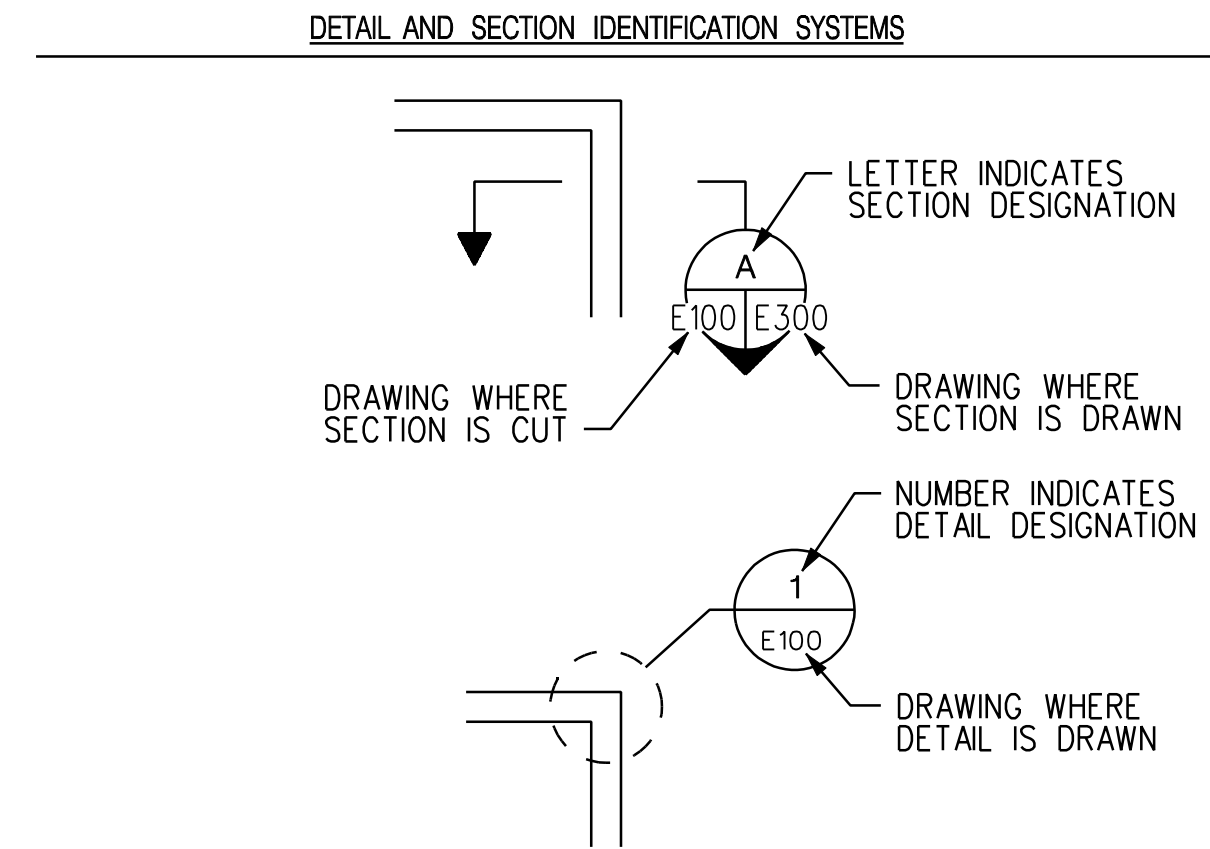
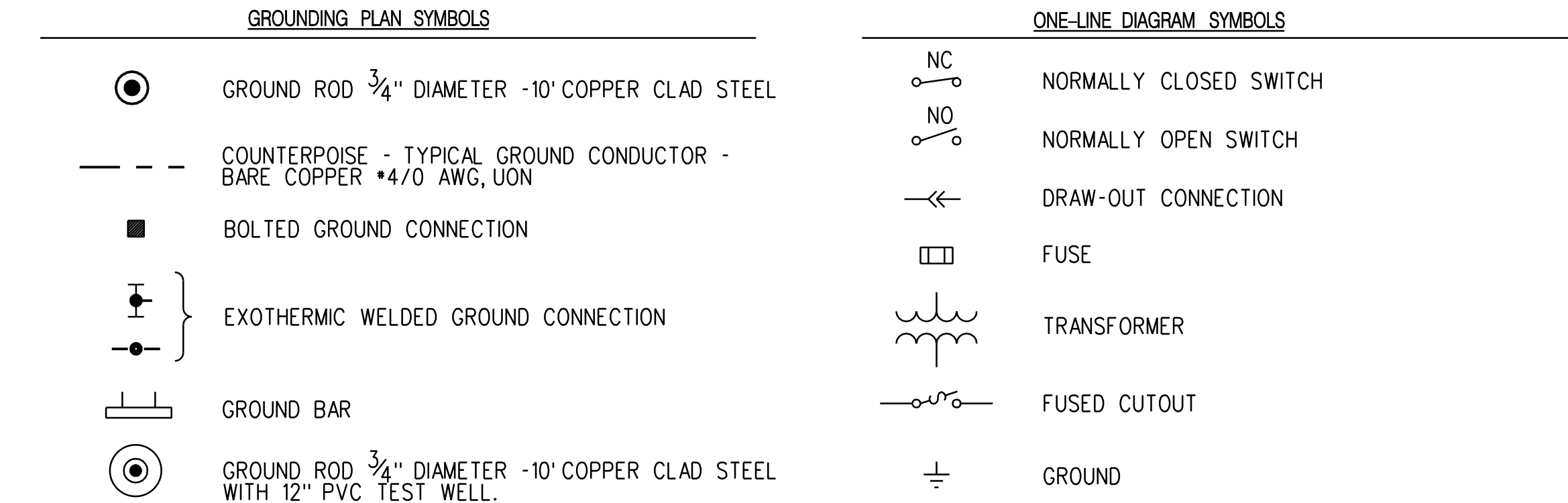
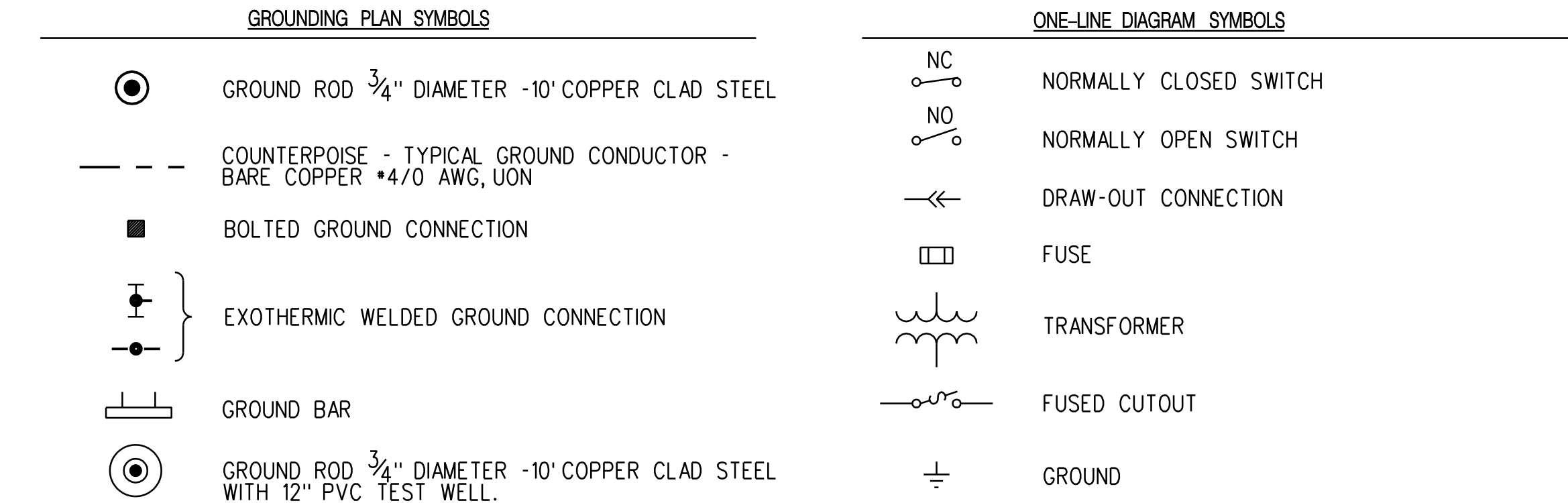
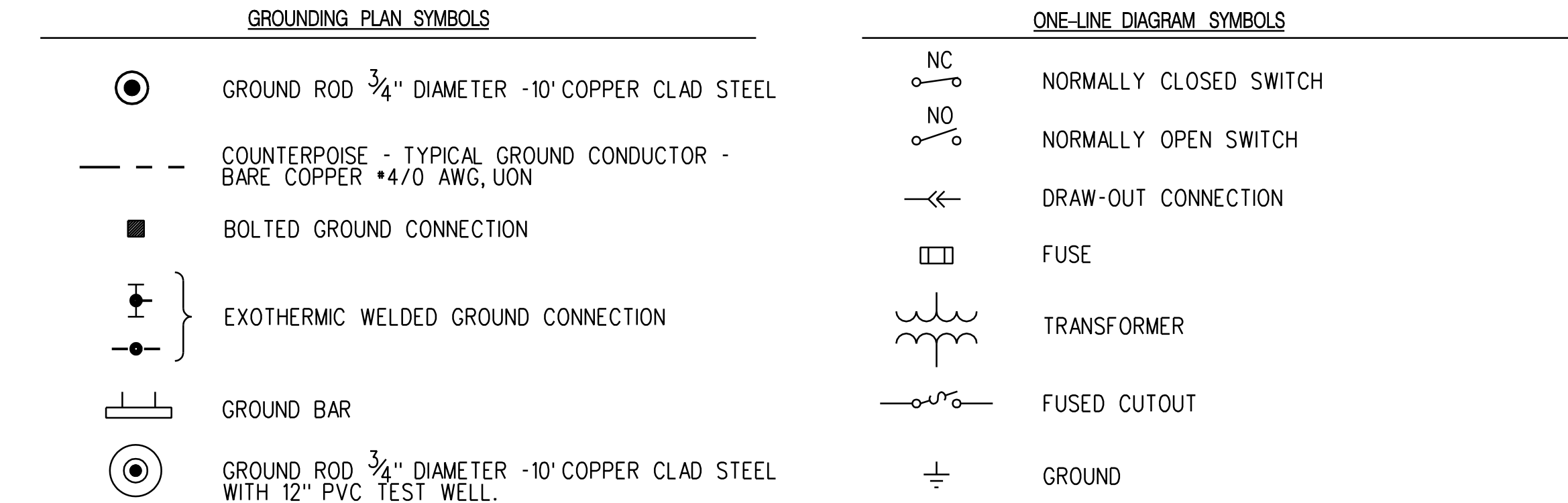
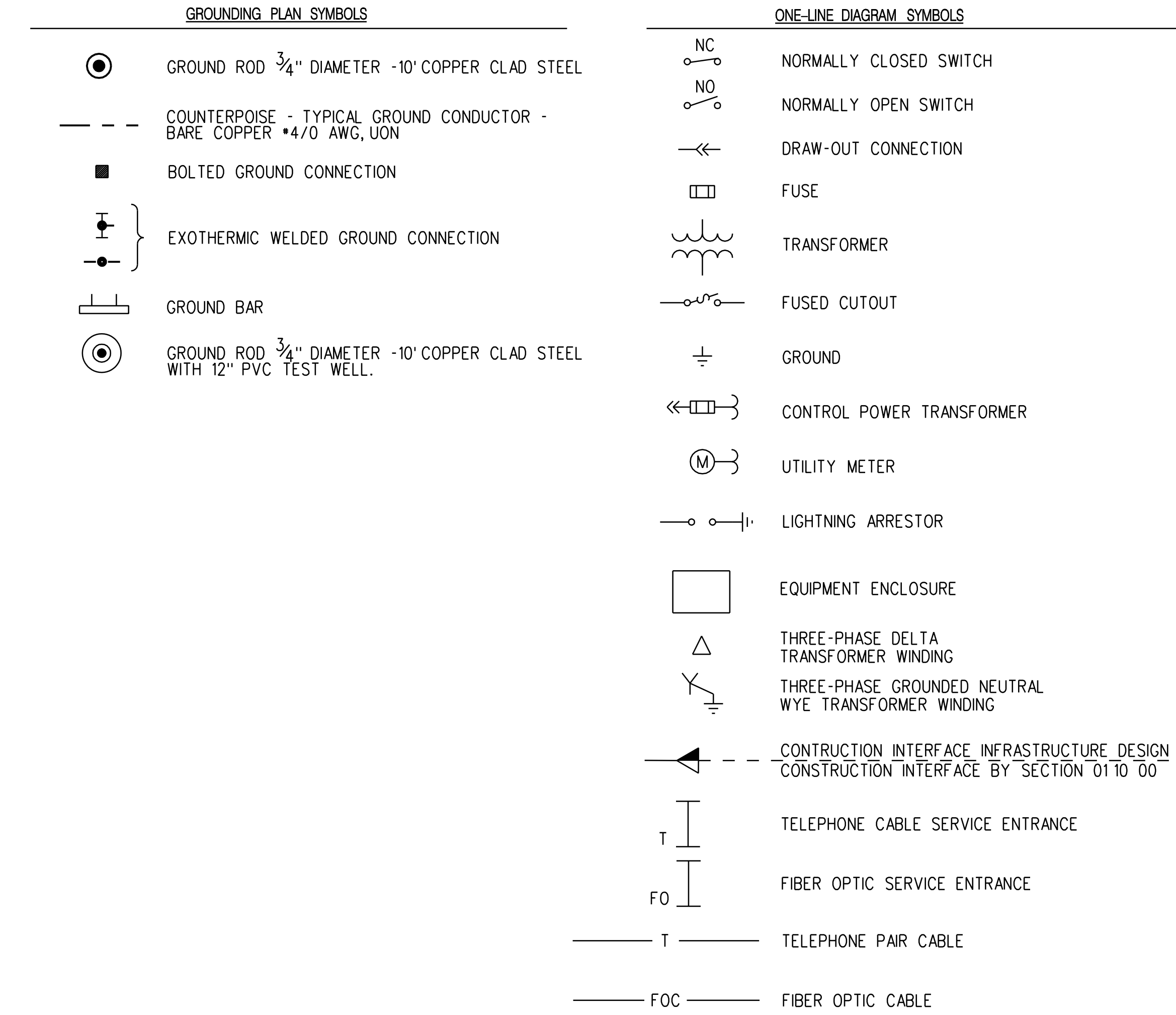
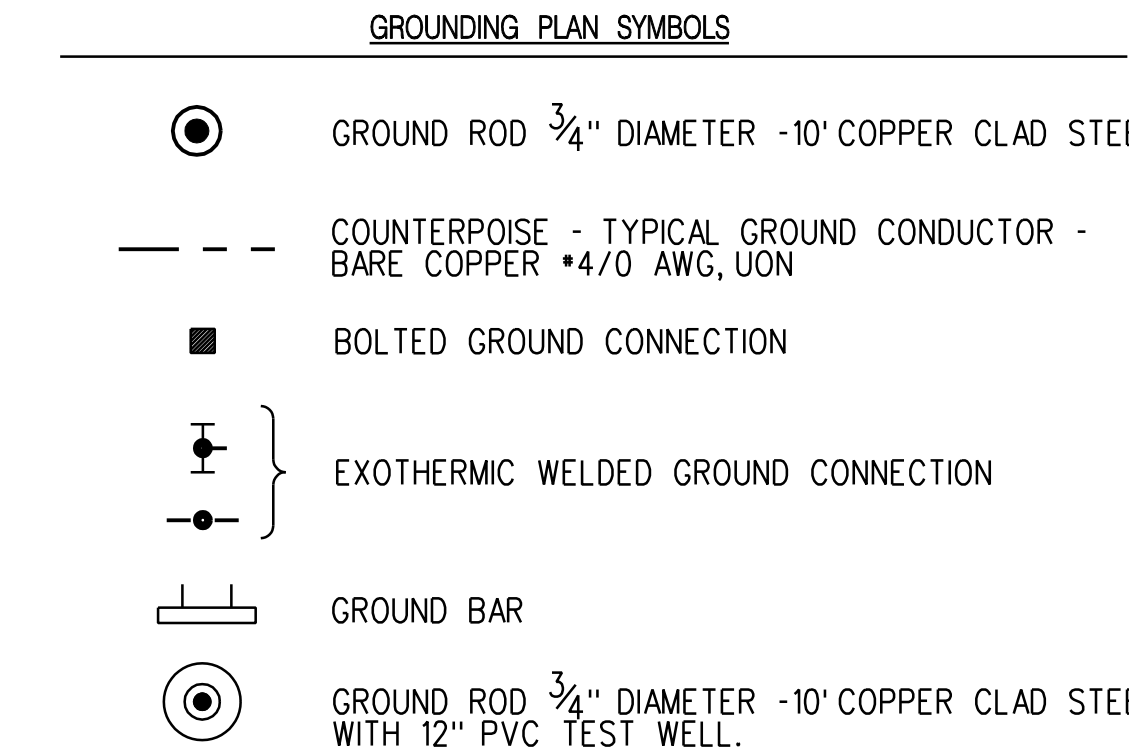
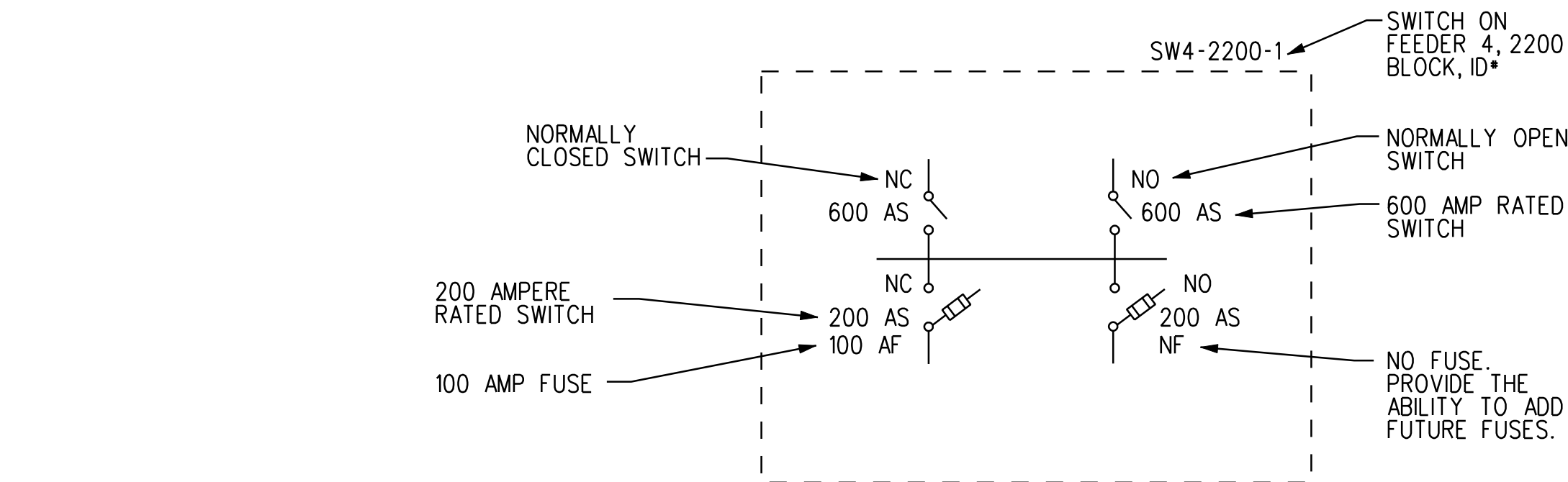
UC DIRECT BURIED PVC DUCT(S) HOUSING FIBER OPTIC AND COPPER COMMUNICATIONS CABLE 4 (2 HIGH X 2 WIDE) 4" PVC CONDUITS U.O.N. SEE E500 SECTION B.

UE2 UNDERGROUND PRIMARY DUCT BANK, CONCRETE ENCASED "2" IS A IDENTIFIER FOR THE CABLE AND DUCT SIZE (SEE TABLE ON E610). SEE E502 SECTION A.

OE OVERHEAD ELECTRIC

E UNDERSLAB/UNDERGROUND ELECTRICAL DUCT-BRANCH OR FEEDER CIRCUITS/DIRECT BURIED, CONCRETE ENCASED UNDER VEHICULAR AREAS. SEE E502 SECTIONS B AND C.

| LIGHT FIXTURE SCHEDULE |   |                  |                                    |                |                 |               |   |       |               |
|------------------------|---|------------------|------------------------------------|----------------|-----------------|---------------|---|-------|---------------|
| FIXTURE TYPE           | ACCEPTABLE MANUFACTURER / MODEL NUMBER    | DISTRIBUTION     | LAMP QUANTITY AND WATTAGE          | INITIAL LUMENS | FIXTURE VOLTAGE | CALCULATED VA | DESCRIPTION   | MOUNT | DETAIL        |
| H1                     | KIM "SMALL ARCHETYPE" LITHONIA AS "AERIS" | IES TYPE 2       | 1 - 70 W PULSE START METAL HALIDE  | 5700           | 277             | 85            | PROVIDE 14' STRAIGHT ROUND DARK BRONZE ALUMINUM POLE WITH STANDARD ARM MOUNT. PROVIDE IN-LINE FUSES AND MULTIVOLT BALLAST.  | POLE  | 4, SHEET E502 |
| H2                     | KIM "ARCHETYPE" LITHONIA AS "AERIS"       | IES TYPE 3       | 1 - 400 W PULSE START METAL HALIDE | 38,000         | 277             | 470           | PROVIDE 30' STRAIGHT DARK BRONZE ALUMINUM POLE WITH TOP OF CONCRETE BASE 36" ABOVE FINISHED GRADE. PROVIDE IN-LINE FUSES. PROVIDE 24" CURVED ARM AND MULTIVOLT BALLAST. PROVIDE VIBRATION DAMPENER. | POLE  | 5, SHEET E502 |
| H3                     | KIM "ARCHETYPE" LITHONIA AS "AERIS"       | IES TYPE 4W WIDE | 1 - 400 W PULSE START METAL HALIDE | 38,000         | 277             | 470           | PROVIDE 30' STRAIGHT DARK BRONZE ALUMINUM POLE WITH TOP OF CONCRETE BASE 36" ABOVE FINISHED GRADE. PROVIDE IN-LINE FUSES. PROVIDE 24" CURVED ARM AND MULTIVOLT BALLAST. PROVIDE VIBRATION DAMPENER. | POLE  | 5, SHEET E502 |



- GENERAL NOTES:
- SYMBOL SIZE DOES NOT IMPLY EQUIPMENT SIZE, UON.
  - MOUNTING HEIGHT INDICATED IN LEGEND AND ON THE DRAWINGS SHALL BE THE DISTANCE MEASURED FROM THE CENTER OF DEVICE TO THE FINISHED GRADE.
  - MOUNTING HEIGHT FOR LIGHT FIXTURES SHALL BE FROM THE BOTTOM OF THE FIXTURE TO THE FINISHED GRADE.
  - NOT ALL SYMBOLS USED ON THIS DRAWING ARE USED ON THIS PROJECT.
  - ALL COMMUNICATION WORK SHALL BE IN ACCORDANCE WITH TECHNICAL CRITERIA FOR INSTALLATION OF INFORMATION INFRASTRUCTURE ARCHITECTURE (ISA), FEBRUARY 2010.

| SYMBOL MODIFIERS |                            |  |
|------------------|----------------------------|--|
| EGC              | EQUIPMENT GROUND CONDUCTOR |  |
| EP, EXP          | EXPLOSIONPROOF.            |  |
| F                | FLOOR MOUNTED.             |  |
| GFI              | GROUND FAULT INTERRUPTER.  |  |
| IG               | ISOLATED GROUND.           |  |
| W                | WALL MOUNTED, 48" AFF.     |  |
| WP               | WEATHERPROOF.              |  |
| WPIU             | WEATHERPROOF, WHILE IN USE |  |
| C                | CEILING MOUNTED            |  |

| ABBREVIATIONS |   |         |  |
|---------------|---|---------|--|
| A             | AMPERES                                   | IMC     | INTERMEDIATE METAL CONDUIT                             |
| AC            | ALTERNATING CURRENT                       | KV      | KILOVOLTS  |
| ACCU          | AIR-COOLED CONDENSING UNIT                | LC      | LIGHTING CONTACTOR                                     |
| ACSR          | ALUMINUM CONDUCTOR STEEL REINFORCED       | LTC     | LOAD TAP CHANGER                                       |
| ADA           | AIR DEFENSE ARTILLERY                     | LV      | LOW VOLTAGE  |
| AFF           | ABOVE FINISHED FLOOR                      | MAX     | MAXIMUM  |
| AFG           | ABOVE FINISHED GRADE                      | MCP     | MOTOR CIRCUIT PROTECTOR                                |
| AHU           | AUTHORITY HAVING JURISDICTION             | MCOV    | MAXIMUM CONTINUOUS OPERATING VOLTAGE                   |
| AIC           | AIR HANDLING UNIT                         | MDP     | MAIN DISTRIBUTION PANEL                                |
| AL            | ALUMINUM                                  | MH      | METAL HALIDE   |
| ATS           | AUTOMATIC TRANSFER SWITCH                 | MIN     | MINIMUM  |
| AWG           | AMERICAN WIRE GAUGE                       | MOV     | METAL OXIDE VARISTOR                                   |
| AVE           | AVERAGE                                   | MV      | MEDIUM VOLTAGE   |
| BC            | BARE COPPER                               | N       | NEUTRAL  |
| BIL           | BASIC IMPULSE LEVEL                       | NEC     | NATIONAL ELECTRICAL CODE                               |
| BAT           | BATTALION                                 | NEC     | NETWORK ENTERPRISE CENTER (FORMERLY DDM)               |
| BP            | BYPASS                                    | NTS     | NOT TO SCALE   |
| C             | CONDUIT                                   | OC      | ON CENTER  |
| CAT 6         | EIA/TIA 568-B CATEGORY 6 CABLE            | OH      | OVERHEAD LINE  |
| CCT OR CKT    | CIRCUIT                                   | P       | PUBLIC ADDRESS   |
| CD            | CANDELA                                   | PA      | PHOTOCELL  |
| CM            | CIRCULAR MIL                              | PCU     | PREMISE CONTROL UNIT                                   |
| COMM          | COMMUNICATIONS                            | PLCS    | PLACES   |
| CPT           | CONTROL POWER TRANSFORMER                 | PVC     | POLY-VINYL CHLORIDE                                    |
| DOM           | DEPARTMENT OF INFORMATION MANAGEMENT      | PV      | POST INDICATOR VALVE                                   |
| EC            | EMPTY CONDUIT                             | RCT     | REMOTE CONTROL SWITCH                                  |
| EF            | EXHAUST FAN OR EACH FACE                  | RGS     | RIGID GALVANIZED STEEL                                 |
| EMT           | ELECTRICAL METALLIC TUBING                | RMS     | ROOT MEAN SQUARE                                       |
| EMCS          | ENERGY MANAGEMENT CONTROL SYSTEM          | SDBC    | SOFT DRAWN BARE COPPER                                 |
| EP            | EXPLOSION-PROOF                           | SIPRNET | SECRET INTERNET PROTOCOL ROUTER                        |
| EPR           | ETHYLENE PROPYLENE RUBBER                 | STR     | STRANDED   |
| EW            | EACH WAY                                  | STU     | SECURE TELEPHONE UNIT                                  |
| EXP           | EXPLOSION-PROOF                           | SYM     | SYMMETRICAL  |
| FACP          | FIRE ALARM CONTROL PANEL                  | TRP     | TRIPLEX CABLE- THREE INSULATED CABLES TWISTED TOGETHER |
| G OR GND      | GROUND                                    | TVSS    | TYPICAL TRANSIENT VOLTAGE SURGE SUPPRESSION            |
| GFI           | GROUND FAULT CIRCUIT INTERRUPTER          | UG      | UNDERGROUND  |
| GFQI          | GOVERNMENT FURNISHED GOVERNMENT INSTALLED | UL      | UNDERWRITER'S LABORATORIES                             |
| GFP           | GROUND FAULT PROTECTION                   | UNC     | UNCOARSE THREAD  |
| GMP           | GUARANTEED MAXIMUM PRICE                  | UTP     | UNSHIELDED TWISTED PAIR                                |
| GRS           | GALVANIZED RIGID STEEL CONDUIT            | UON     | UNLESS OTHERWISE NOTED                                 |
| H             | PHASE OR HOT CONDUCTOR                    | V       | VOLTS  |
| HID           | HIGH INTENSITY DISCHARGE                  | VFD     | VARIABLE FREQUENCY DRIVE                               |
| HP            | HORSEPOWER                                | W       | WIRE (OR WATT)   |
| HPS           | HIGH PRESSURE SODIUM                      | WIDS    | WIRELESS INTRUSION DETECTION SYSTEM                    |
| HPU           | HYDRAULIC POWER UNIT                      | WT      | WEIGHT   |
| HVAC          | HEATING, VENTILATION AND AIR CONDITIONING | WWF     | WELDED WIRE FABRIC                                     |
| IDS           | INTRUSION DETECTION SYSTEM                | XFMR    | TRANSFORMER  |
| IG            | ISOLATED GROUND                           |         |  |

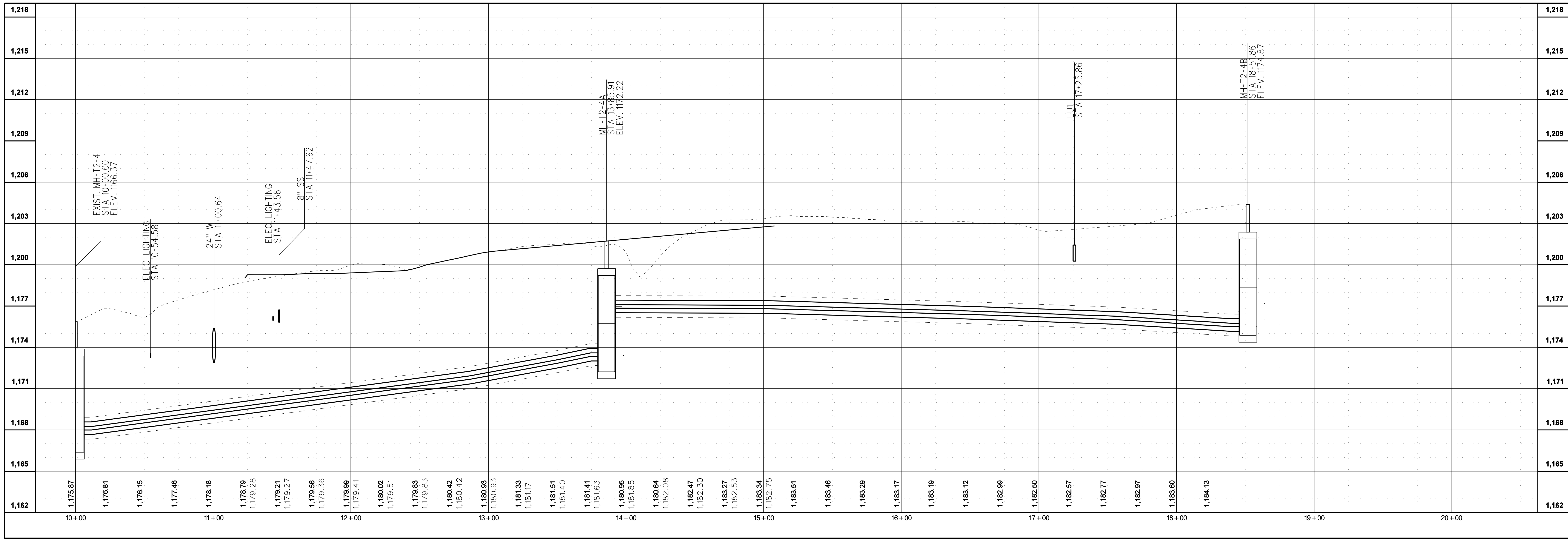
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|--|---|--------------------------|------------------------------|
| DESIGNED BY:<br>B. POOLE   | FORT SILL ARMY POST<br>OKLAHOMA<br>PDC: 65299<br>FY: 10<br>CENTRAL ISSUE FACILITY (CIF)<br><br>ELECTRICAL SYMBOLS, LEGEND AND ABBREVIATIONS |                          |                              |
| DRAWN BY:<br>P. DAMICO   |   |                          |                              |
| REVIEWED BY:<br>T. PARADEIS  |   |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |   |                          |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:  | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10UBE-001  |   | RFP NO.<br>W912BV--      |                              |
| PLOT DATE:<br>XX-XXX-2009  | SHEET<br>29 OF 41   | CONTRACT NO.<br>W912BV-- | E001                         |

D

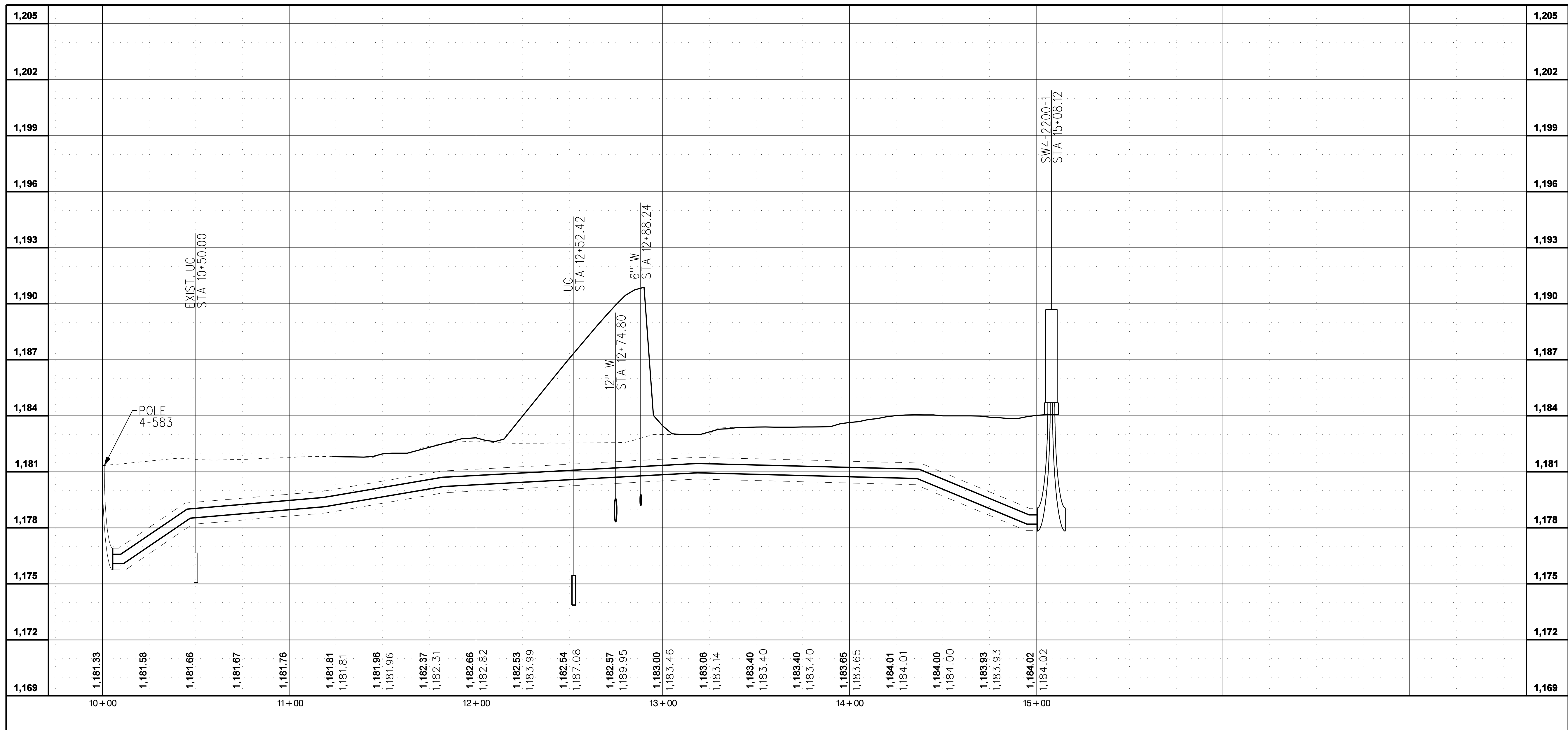
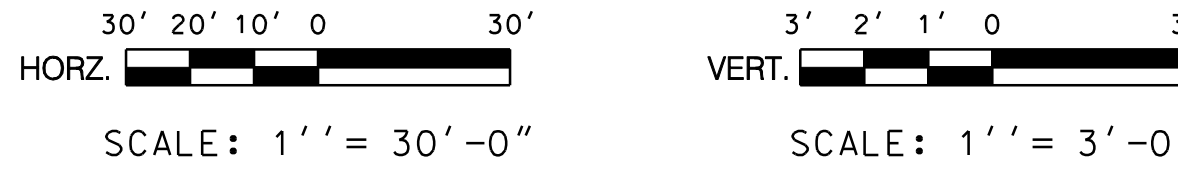
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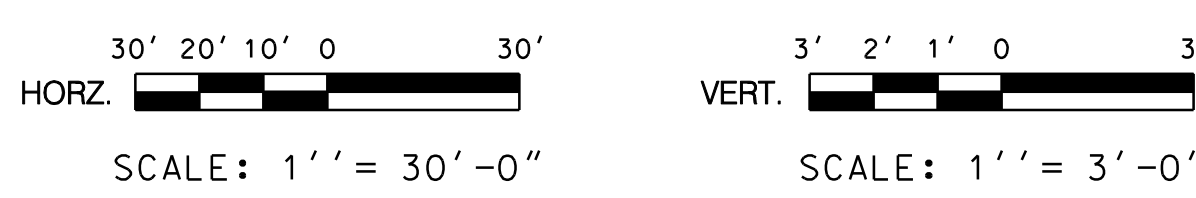
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COMMUNICATION PROFILE 1  
STA 10+00 TO 20+00.00





ELECTRIC PROFILE 1  
STA 20+00.00 TO 25+04.94



NOTES:

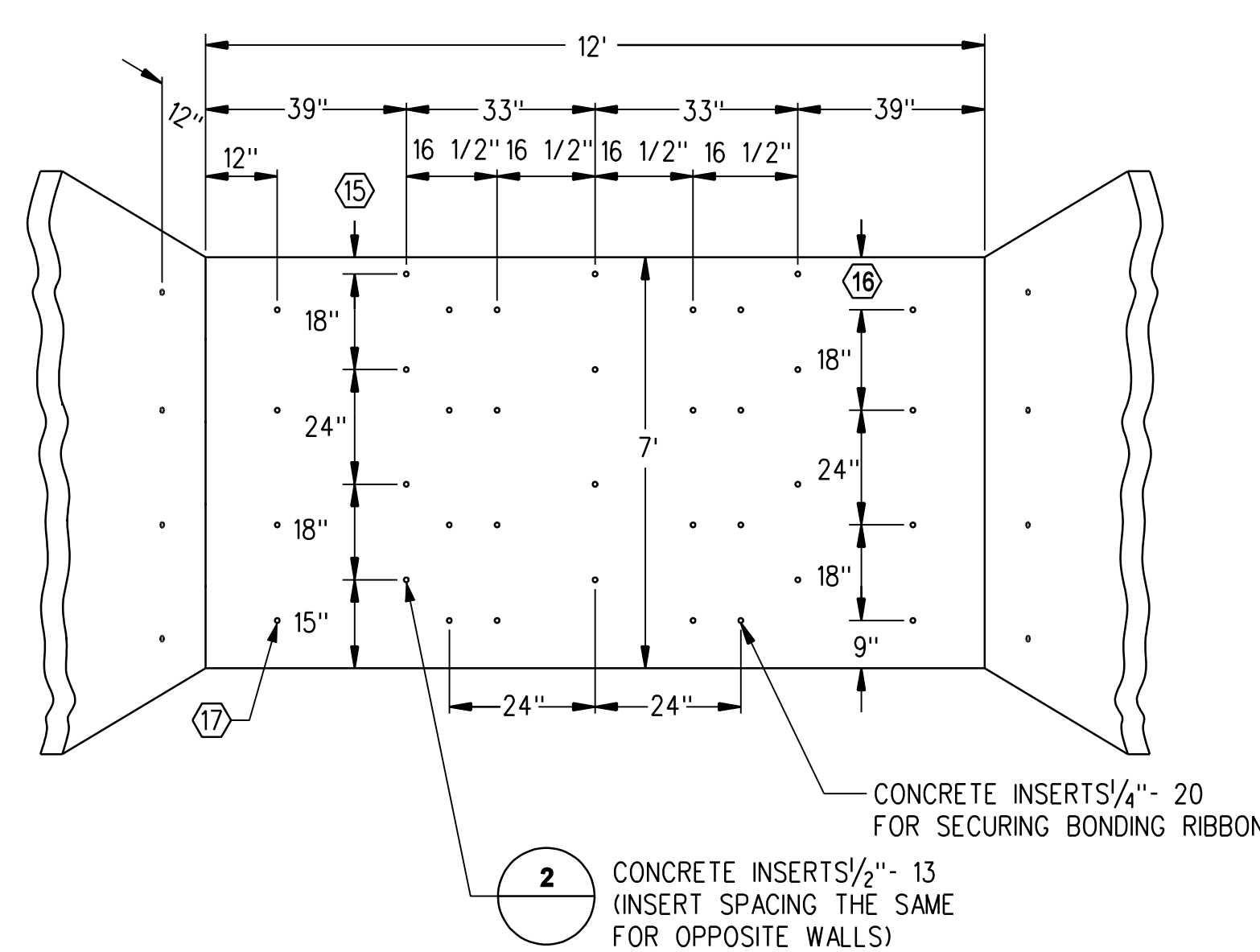
1. SEE ES101 FOR COMMUNICATION DUCTBANK 1 AND ELECTRICAL DUCTBANK 1 LOCATION AND STATION POINTS.
2. ELECTRICAL DUCTBANK 1 CONSISTS OF DUCTBANK BETWEEN POLE 4-583 AND PAD-MOUNTED SWITCH SW-2200-1.
3. COMMUNICATION DUCTBANK 1 CONSISTS OF DUCTBANK BETWEEN EXISTING MANHOLE MH-T2-4 AND NEW MANHOLE MH-T2-4B.

USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"

| SYMBOL   | DESCRIPTION  | DATE                     | APPR                         |
|--|--|--------------------------|------------------------------|
|       | 51121  |                          |                              |
|       | US Army Corps of Engineers   |                          |                              |
| DESIGNED BY:<br>B. POOLE   | FORT SILL ARMY POST<br>OKLAHOMA<br>PDC: 65299<br>CENTRAL ISSUE FACILITY (CIF)<br>COMMUNICATION AND<br>ELECTRIC PROFILES<br>STA 10+00 TO 25+04.94 |                          |                              |
| DRAWN BY:<br>P. DAMICO   |  |                          |                              |
| REVIEWED BY:<br>T. PARADEIS  |  |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |  |                          |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:   | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10UBE-300.DGN  |  | RFP NO.<br>W912BV--      |                              |
| PLOT DATE:<br>XX-XXX-2009  | SHEET<br>30 OF 41  | CONTRACT NO.<br>W912BV-- | <b>E300</b>                  |



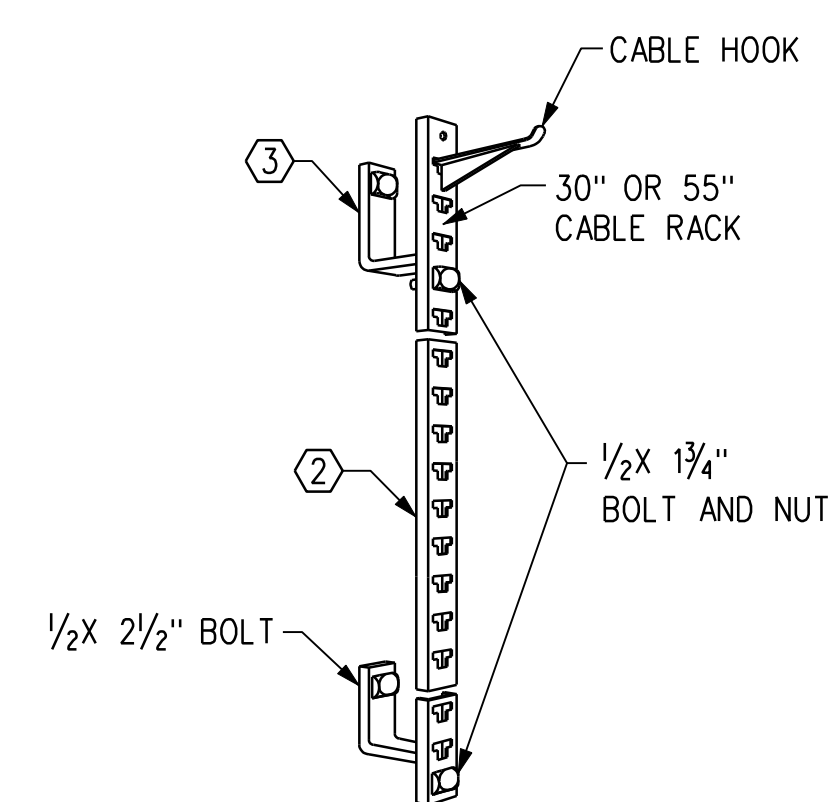
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**38Y STANDARD MANHOLE**

**SECTION** \_\_\_\_\_ **A**

NOT TO SCALE

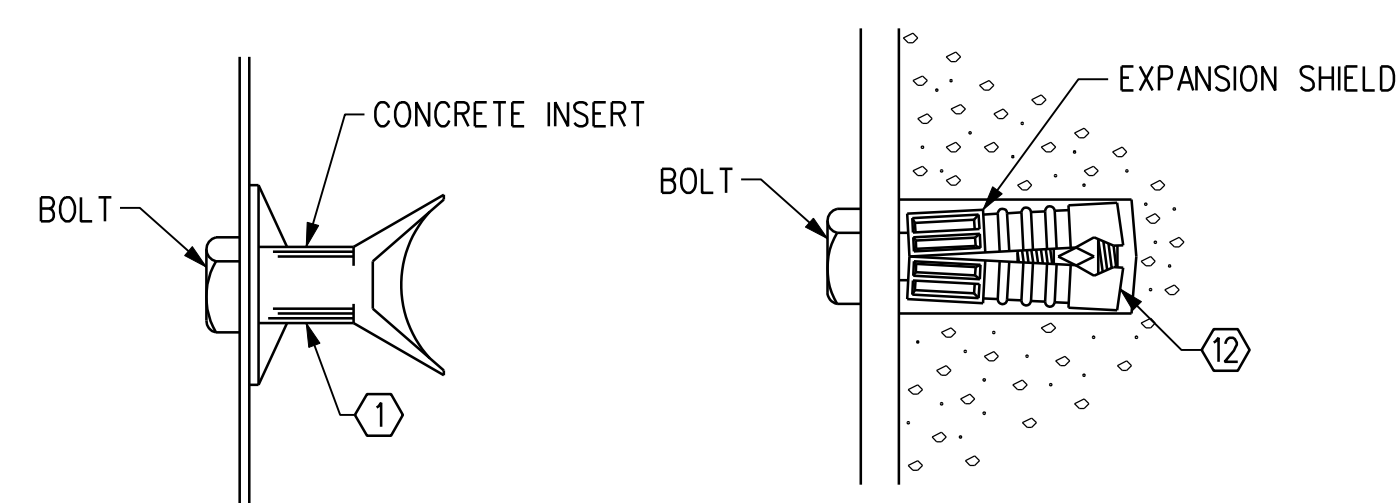


**CABLE RACK**

**DETAIL**

NOT TO SCALE

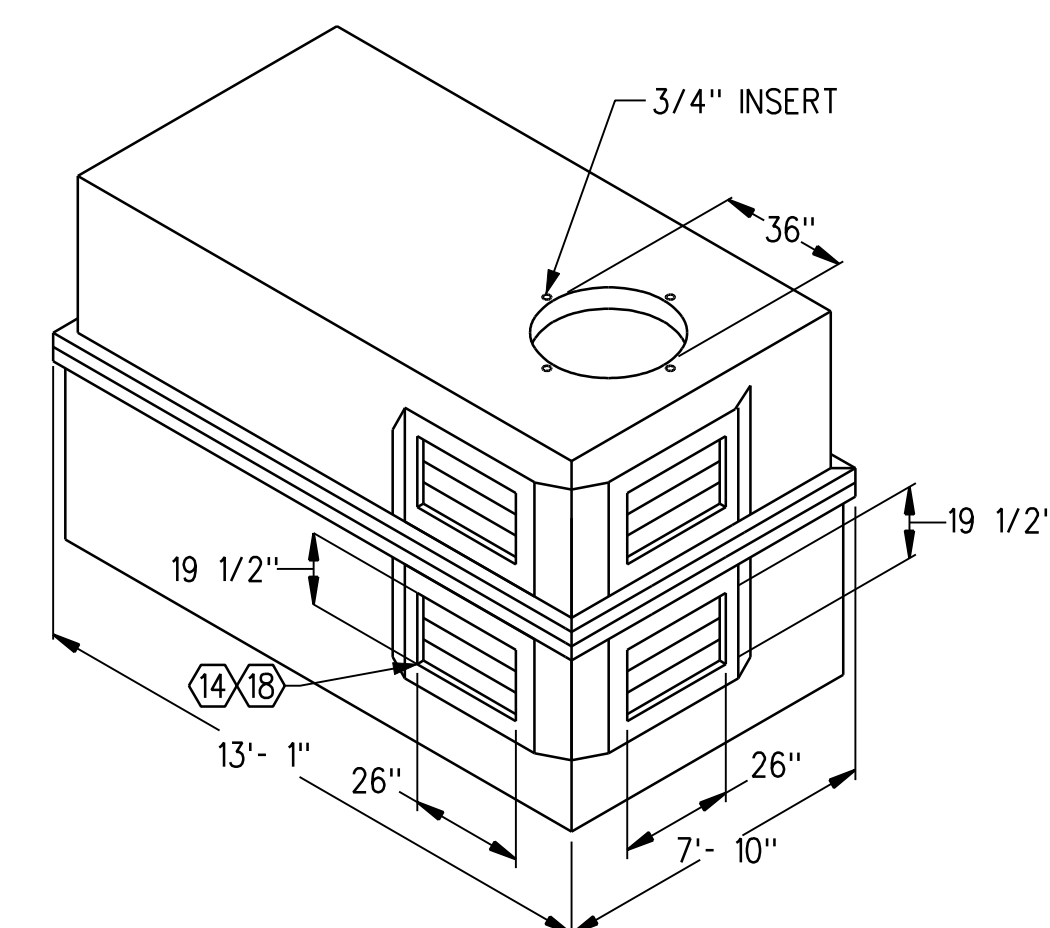
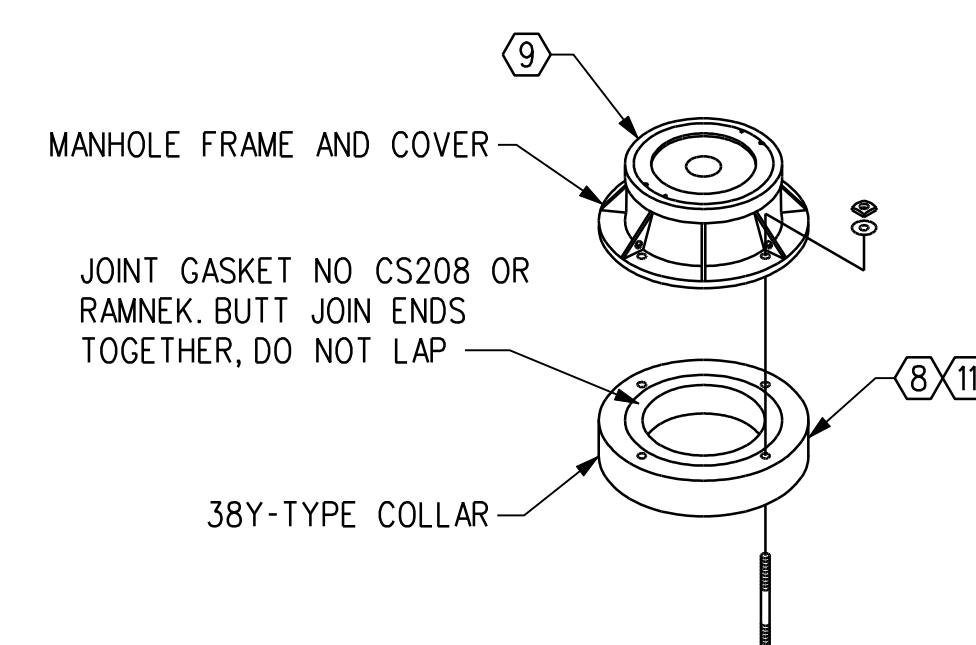
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**CONCRETE INSERTS**

**DETAIL** 2

NOT TO SCALE



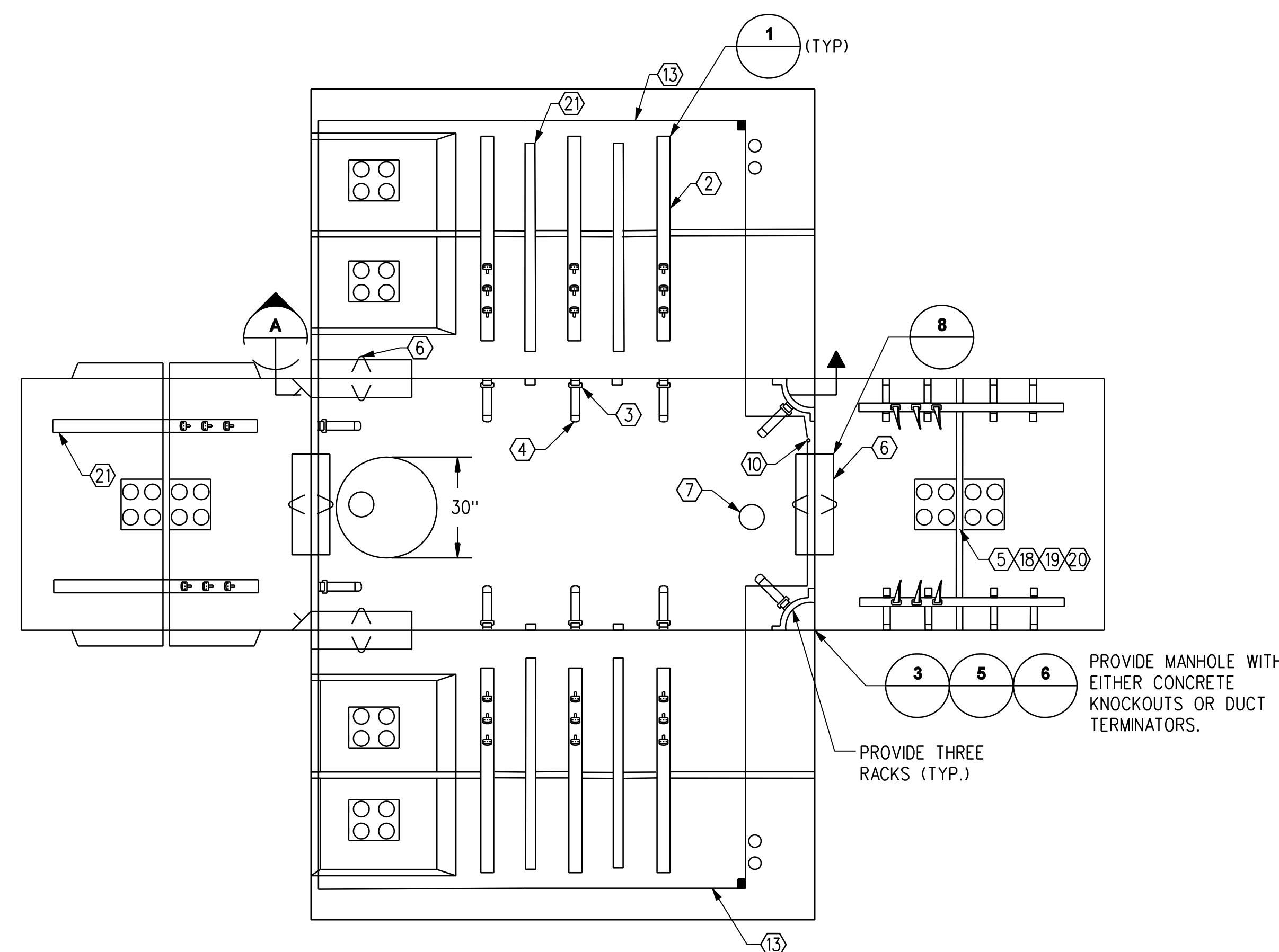
**MANHOLE**

**DETAIL**

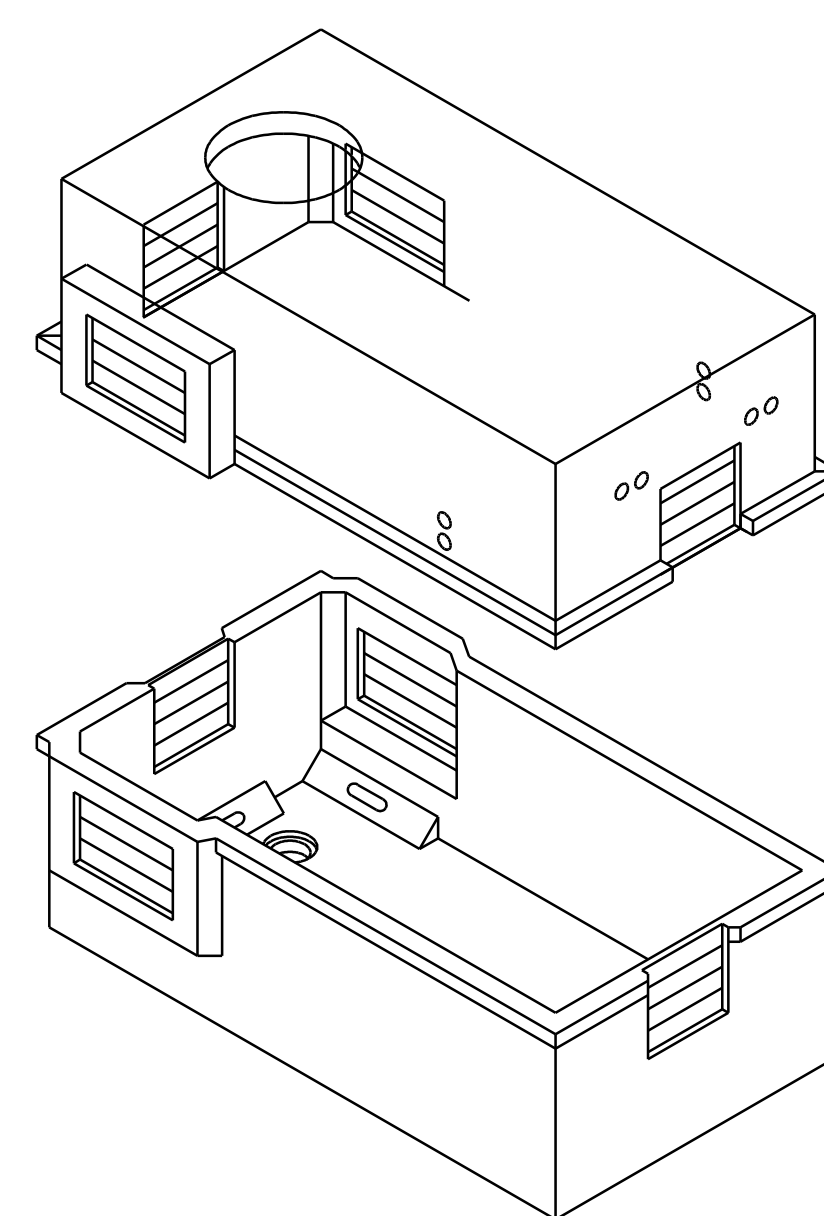
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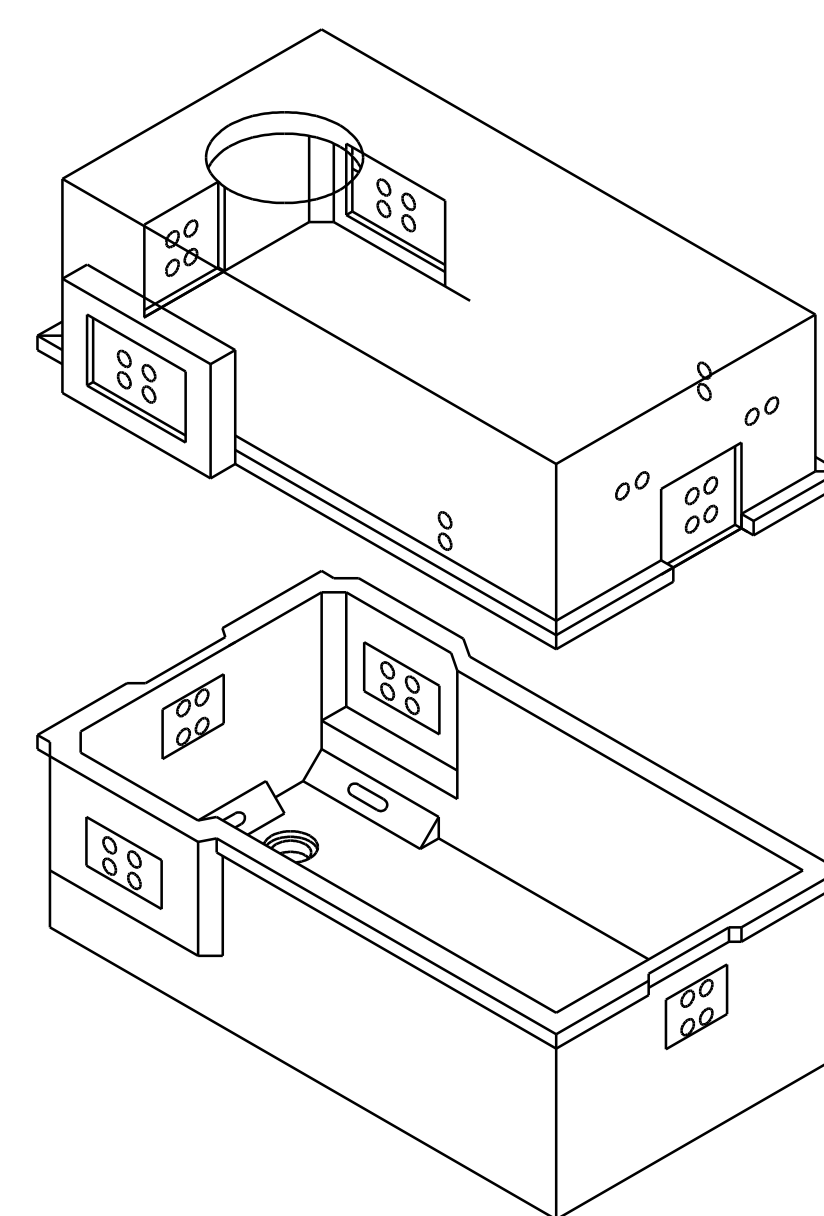
**38Y STANDARD MANHOLE**  
DETAIL  
NOT TO SCALE



**CABLE ENTRANCES WITH  
CONCRETE KNOCKOUTS**

**DETAIL** \_\_\_\_\_ **5**

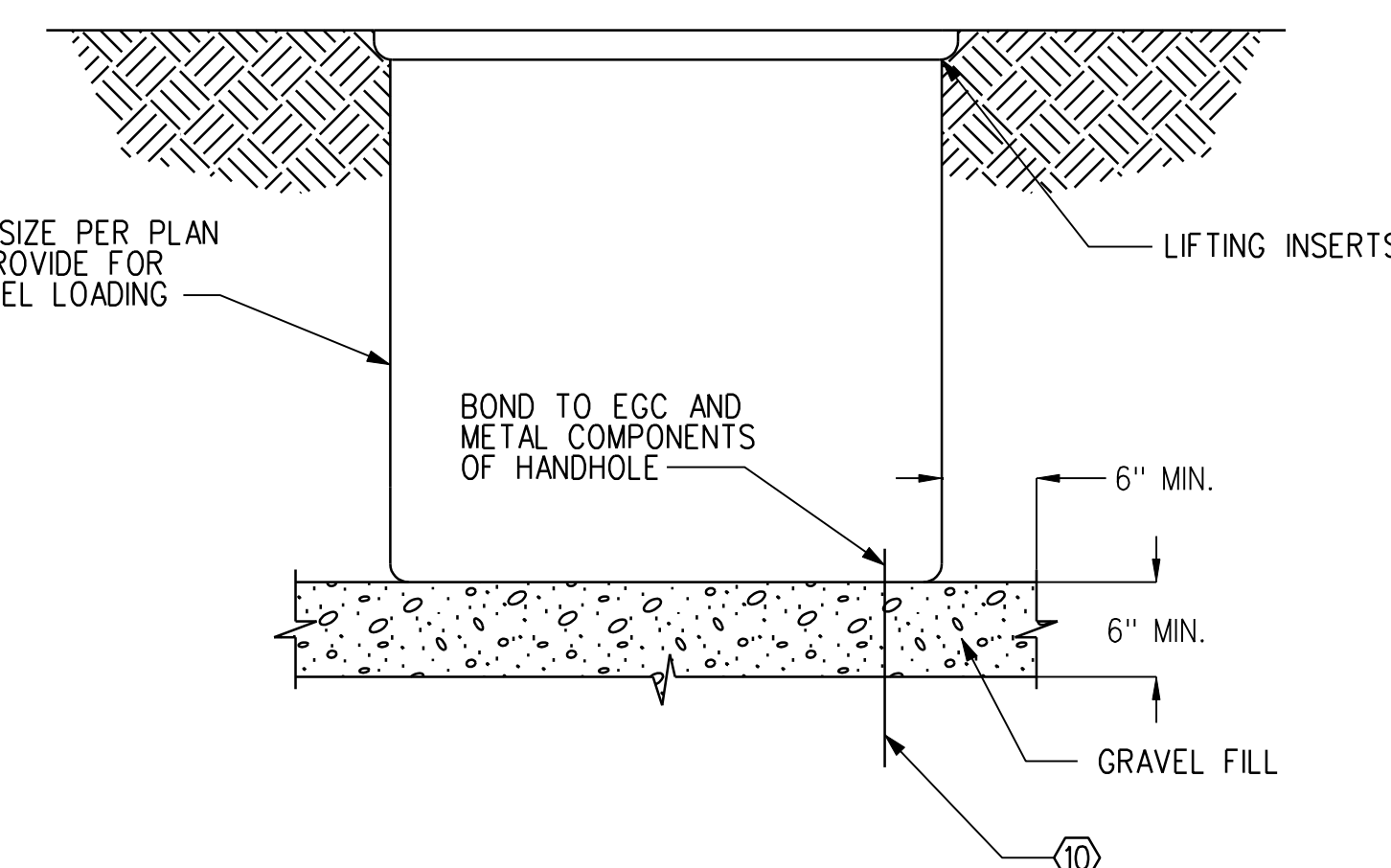
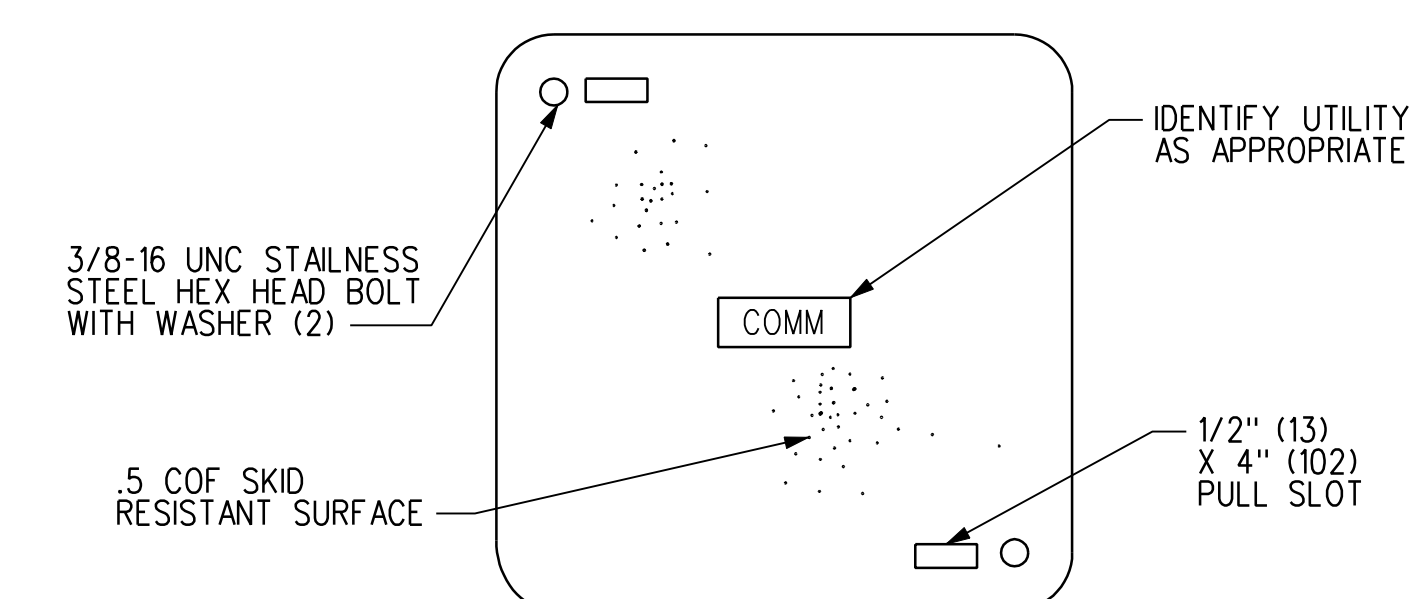
NOT TO SCALE



**CABLE ENTRANCES WITH  
DUCT TERMINATOR OPTION**

**DETAIL** 6

NOT TO SCALE

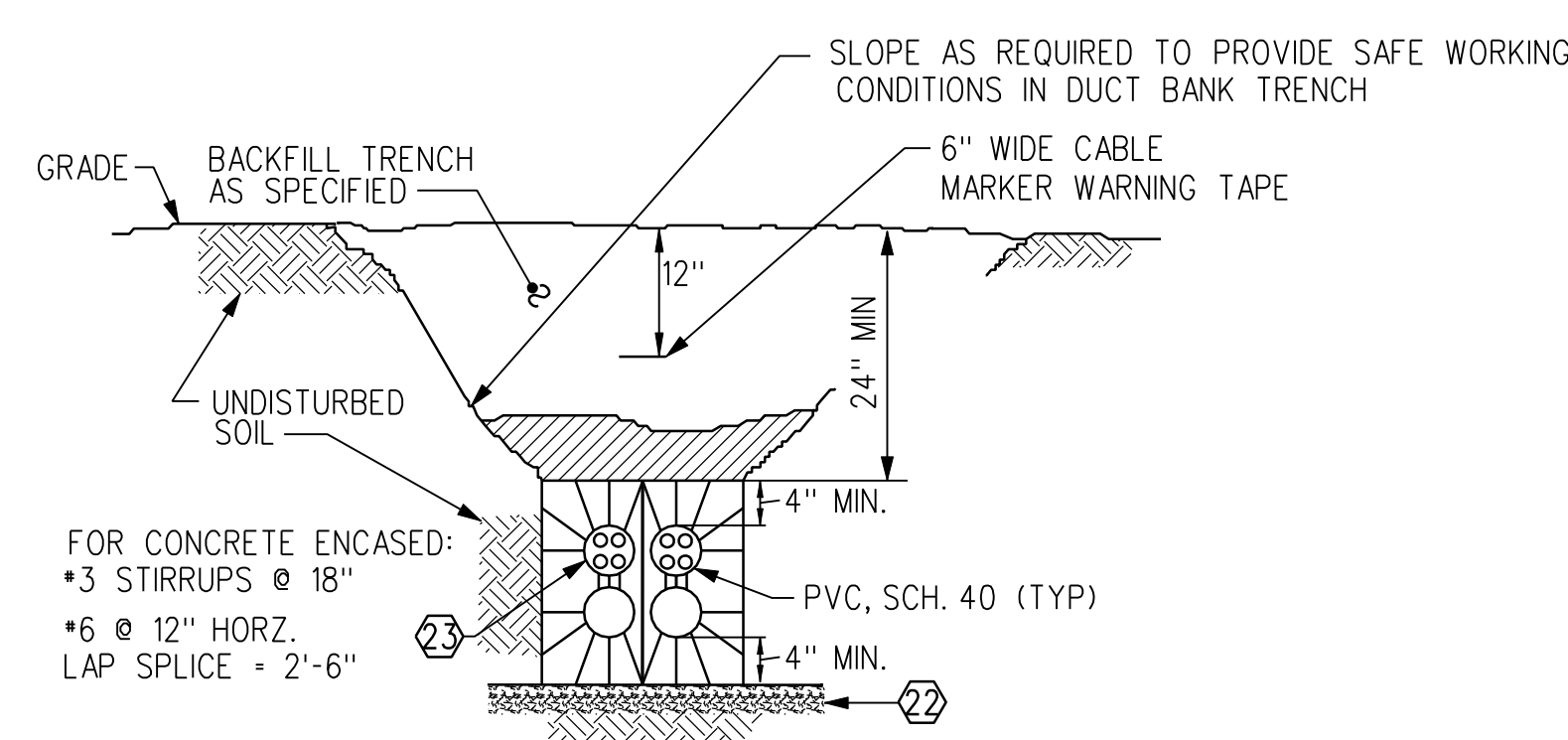


**HANDHOLE**

**SECTION** \_\_\_\_\_ **10**

NOT TO SCALE

**B**

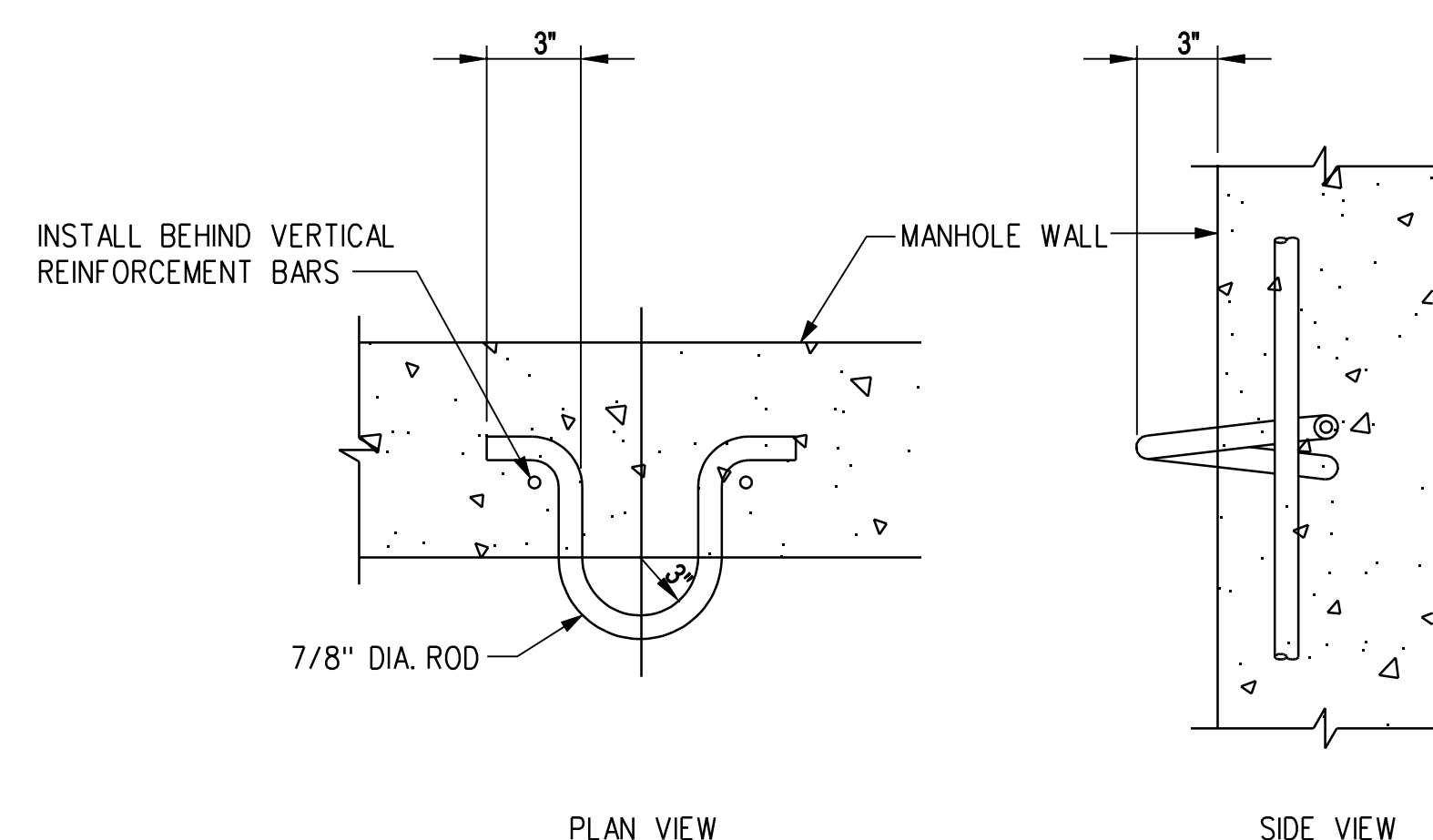


**4-WAY COMMUNICATION  
DUCT BANK**

**SECTION** \_\_\_\_\_

NOT TO SCALE

(B)



**PULLING-IN IRON DETAIL**

**DETAIL** \_\_\_\_\_ **8**

NOT TO SCALE

|        |             |      |      |
|--------|-------------|------|------|
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
|        |             |      |      |
| S      | D           | A    | P    |
| SYMBOL | DESCRIPTION | DATE | APPR |



A

SECTION B NOTES:

1. DUCT BANKS MAY BE EARTH FORMED WITH UNDISTURBED EARTH PROVIDED THE EARTH WILL BE TO A NEARLY VERTICAL SLOPE IF TRENCH IS OVER-EXCAVATED. COMPACT AS SPECIFIED. PROVIDE PLANS FOR NUMBER, SIZE, AND CONFIGURATION OF CONDUIT.
2. IF DOWN CONDUITS AS REQUIRED TO PREVENT THE CONDUIT FROM FLOATING DURING CONCRETE POUR.
3. PROVIDE 4" - 1" INNETS IN TWO CONDUITS IN EACH 4-WAY DUCT BANK.
4. CONDUIT SPACING SHALL BE 3 INCHES BETWEEN OUTSIDE WALLS.
5. ALL DUCT BANKS ARE TO BE ENCLOSED IN CONCRETE WHEN ROUTED UNDER ROADS OR AS INDICATED ON PLANS.
6. CONDUITS SHALL BE SLOPED A MINIMUM OF 4" PER 100' FROM MANHOLE TO MANHOLE TO STUB UP TO PROVIDE DRAINAGE TO MANHOLE SUMPS.
7. BACKFILL -
- A. ALL BACKFILL MATERIALS FROM TRENCHES AND OTHER EXCAVATION IN THIS CONTRACT AND/OR FROM THE ON SITE BORROW AREAS AS DESIGNATED BY THE RESIDENT PROJECT REPRESENTATIVE.
- B. BACKFILL MATERIALS SHALL INCLUDE MATERIAL THAT IS FREE OF DEBRIS, STONES, ORGANIC MATTER, BUTS UNDETERMINED FROZEN MATTER AND ALSO FREE OF ROCK WITH A DIMENSION GREATER THAN 2 INCHES.
8. COMPACTION -
- A. PLACE BACKFILL MATERIAL IN LEVEL LAYERS 15 TO 6 INCHES.
- B. USE HAND METHODS TO A HORIZONTAL PLANE 6 INCHES ABOVE TOP OF CONDUIT.
- C. USE APPROVED MECHANICAL METHODS WHERE HAND BACKFILL IS REQUIRED.
- D. FOR BACKFILL COMPACTION AND MOISTURE CONTROL REQUIREMENTS.

| EQUIPMENT/ MATERIAL SUPPLIED<br>WITH A STANDARD MANHOLE OR<br>HANDHOLE | INLINE   |            |             | MULTIDIRECTIONAL |            |             |
|--|----------|------------|-------------|------------------|------------|-------------|
|  | HANDHOLE | MANHOLE    |             | HANDHOLE         | MANHOLE    |             |
|  | 4'X4'X4' | 12'X6'X7'H | 12'X6'X10'H | 4'X4'X4'         | 12'X6'X7'H | 12'X6'X10'H |
| BONDING RIBBON #6 AWG  | 20       | 65         | 65          | 20               | 65         | 65          |
| BONDING RIBBON CLAMPS  | 12       | 20         | 20          | 12               | 20         | 20          |
| CABLE RACK 30"   | 4        |            |             | 4                |            |             |
| CABLE RACK 47 HOLE   |          | 14         | 14          |                  | 14         | 14          |
| B CORNER CABLE RACK SUPPORT  |          | 8          | 8           |                  | 8          | 8           |
| CABLE RACK HOOK 7 1/2"   | 8        | 14 MINIMUM | 14 MINIMUM  | 8                | 14 MINIMUM | 14 MINIMUM  |
| CABLE RACK STAND OFF BRACKET   | 8        | 12         | 12          | 8                | 12         | 12          |
| CONCRETE COLLAR 6"   | 1        | 1          | 1           | 1                | 1          | 1           |
| COVER (LID) 30" DIAMETER   | 1        | 1          | 1           | 1                | 1          | 1           |
| FRAME (SUPPORT STRUCTURE FOR LID)                                      | 1        | 1          | 1           | 1                | 1          | 1           |
| GROUND ROD 5/8" X 8' GALV  | 1        | 1          | 1           | 1                | 1          | 1           |
| GROUND ROD CLAMP 5/8"  | 1        | 1          | 1           | 1                | 1          | 1           |
| METAL HIT ANCHOR   | 10       | 20         | 20          | 10               | 20         | 20          |
| PULL-IN IRONS  | 4        | 4          | 4           | 4                | 4          | 4           |
| SPUD   |          |            |             |                  |            |             |

| 38Y PRECAST MANHOLE            |      |       |                             |      |      |
|--------------------------------|------|-------|-----------------------------|------|------|
| CONCRETE THICKNESS<br>(INCHES) |      |       | INSIDE DIMENSIONS<br>(FEET) |      |      |
| WALLS                          | ROOF | FLOOR | LONG                        | WIDE | HIGH |
| 5                              | 6    | 5     | 12                          | 6    | 7    |

|   |  |  |  |                               |  |
|---|--|--|--|-------------------------------|--|
|      |  |   |  | US Army Corps<br>of Engineers |  |
| 51121   |  |  |  |                               |  |
| DESIGNED BY:<br><b>B. POOLE</b>   |  | FORT SILL ARMY POST<br>OKLAHOMA<br><br>PDC: 62599<br><br>CENTRAL ISSUE FACILITY<br>(CIF)<br><br><b>COMMUNICATION MANHOLE DETAILS</b> |  |                               |  |
| DRAWN BY:<br><b>P. DAMICO</b>   |  |  |  |                               |  |
| REVIEWED BY:<br><b>T. PARADEIS</b>  |  |  |  |                               |  |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC |  |  |  |                               |  |
| PLOT SCALE:<br><b>AS SHOWN</b>  |  | DWG. CODE:   |  | CONTRACT DATE:                |  |
| DESIGN FILE:<br><b>FS10CFE-500</b>  |  | RFP NO.<br>W612BV--  |  | SHEET<br>REFERENCE<br>NUMBER  |  |
| PLOT DATE: 0000   |  | SHEET 31 OF 41   |  | CONTRACT NO.<br>W612BV--      |  |
|   |  |  |  | <b>E500</b>                   |  |



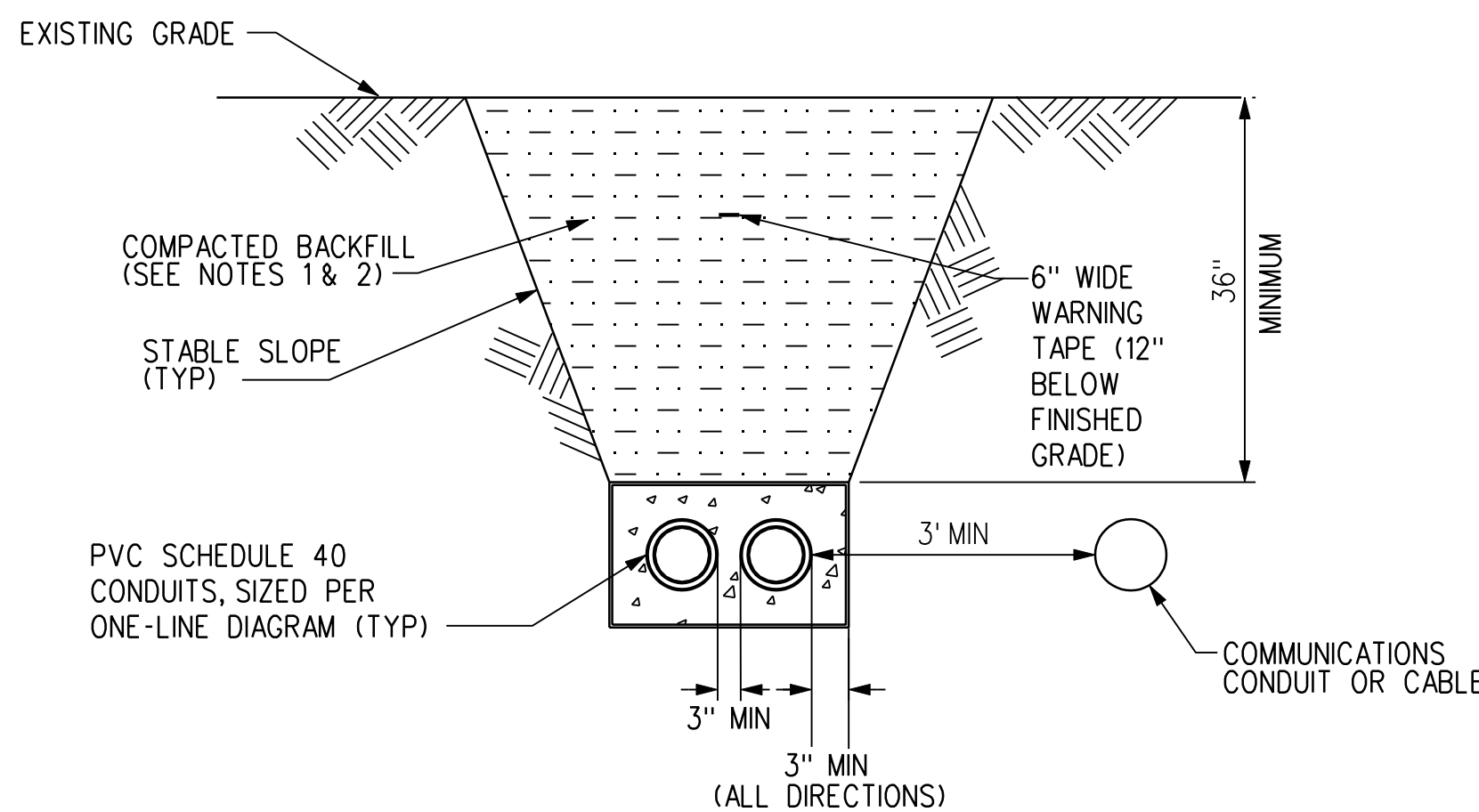


A

B

C

D



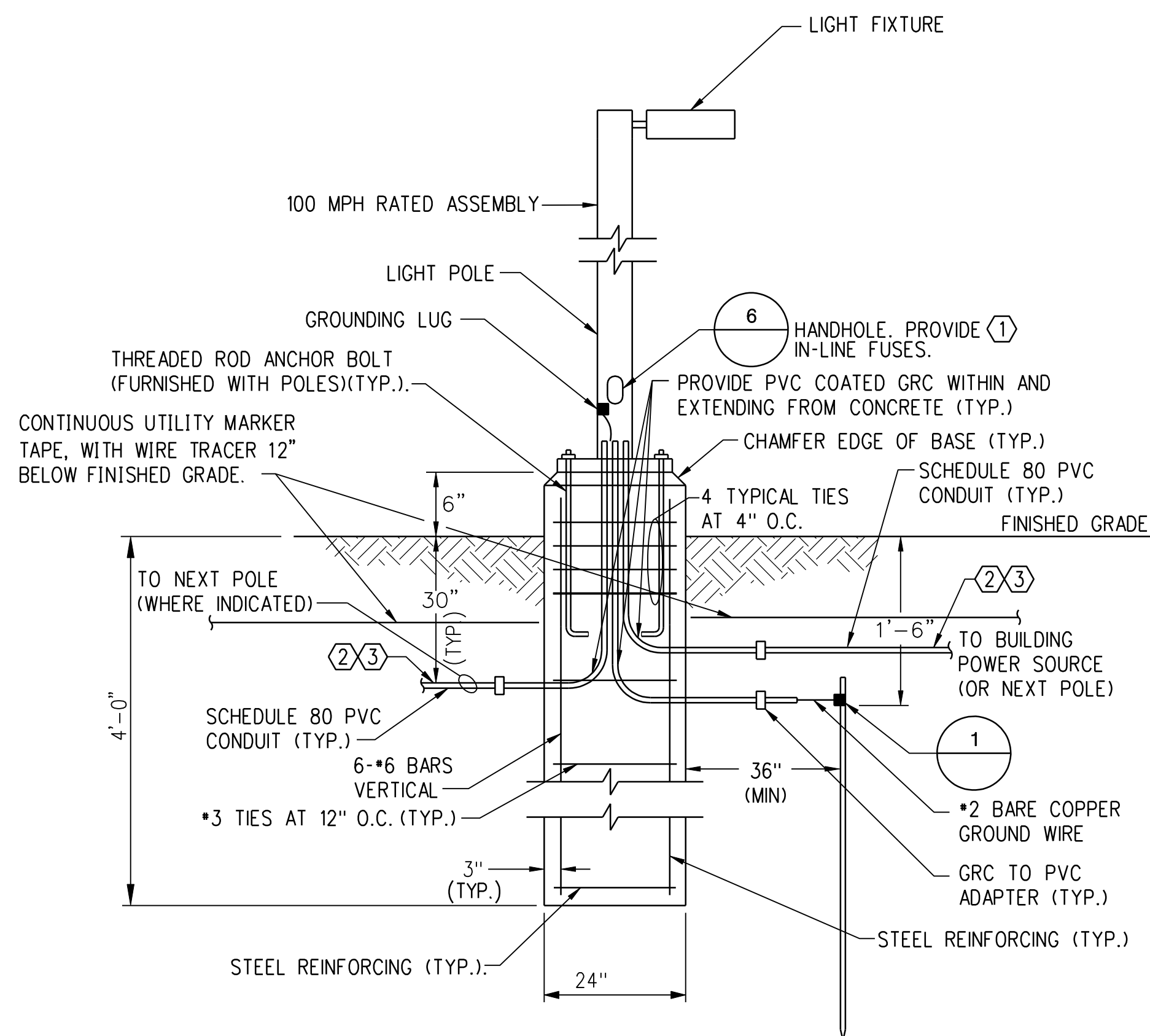
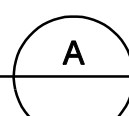
SECTION A AND C NOTES:

- BACKFILL-
  - OBTAIN BACKFILL MATERIALS FROM TRENCHES AND OTHER EXCAVATION IN THIS CONTRACT AND/OR FROM THE ON SITE BORROW AREAS AS DESIGNATED BY THE CONTRACTING OFFICER'S REPRESENTATIVE.
  - BACKFILL MATERIALS INCLUDE MATERIAL THAT IS FREE OF DEBRIS, ROOTS, ORGANIC MATTER, REFUSE, CINDERS, FROZEN MATTER AND ALSO FREE OF ROCK WITH A DIMENSION GREATER THAN 2".
- COMPACTION-
  - PLACE BACKFILL MATERIAL IN LEVEL LAYERS NOT EXCEEDING 3" TO 6".
  - USE APPROVED MECHANICAL METHODS WHERE HAND BACKFILL IS NOT REQUIRED.
  - BACKFILL COMPACTION SHALL BE 95% MOISTURE CONTENT SHALL BE -2 TO +3% OF OPTIMUM MOISTURE CONTENT.
- TOP OF THE CONCRETE ENCASEMENT SHALL NOT BE LESS THAN 36" BELOW GRADE.
- ALL DUCTBANK BENDS SHALL BE FACTORY BENDS "i.e." HEATED CONDUIT BENDS ARE NOT ACCEPTABLE.
- SLOPE DUCTS TOWARDS MANHOLE. MINIMUM SLOPE SHALL BE 4" FOR EVERY 100 FT.
- PROVIDE MINIMUM 3" CONCRETE COVER IN ALL DIRECTIONS OF CONDUIT.
- PROVIDE WARNING TAPE, CENTERED ON DUCTBANK, 12" BELOW GRADE.

TYPICAL 2-WAY MEDIUM VOLTAGE CONCRETE ENCASED BURIED DUCT BANK INSTALLATION

SECTION

NOT TO SCALE

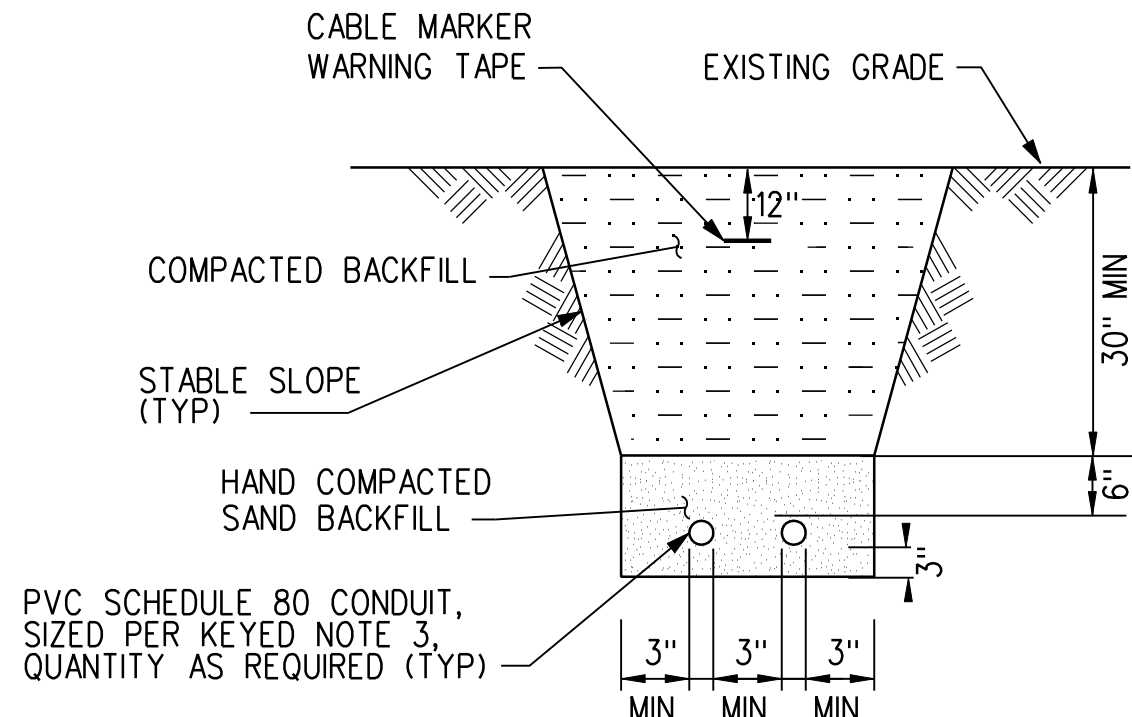
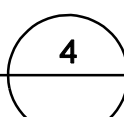


NOTE:  
1. FOR FIXTURE TYPE: H1

TYPICAL PEDESTRIAN PATHWAY LIGHT POLE FOUNDATION DETAIL

DETAIL

NOT TO SCALE



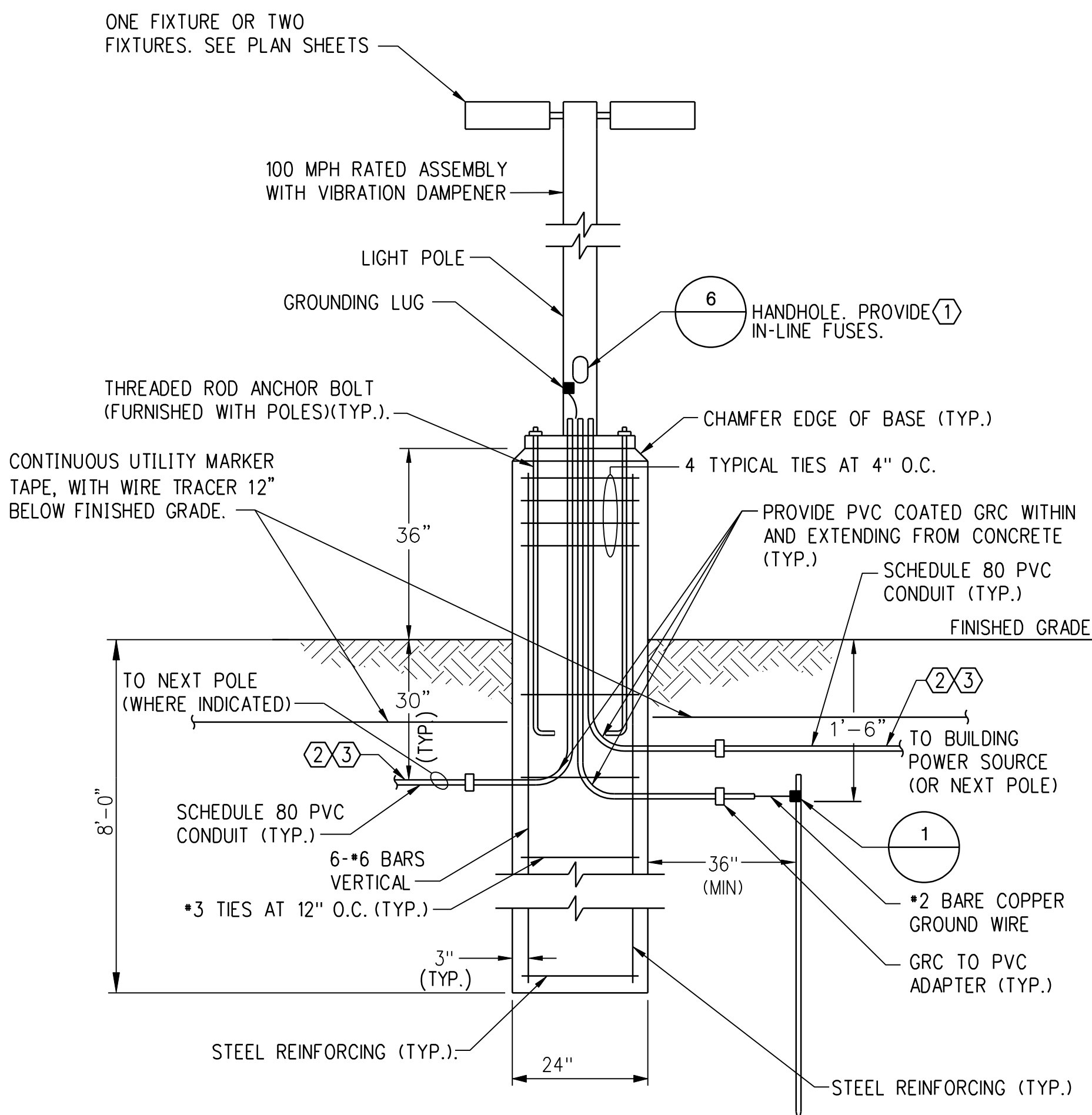
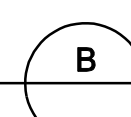
SECTION B NOTES:

- BACKFILL-
  - OBTAIN BACKFILL MATERIALS FROM TRENCHES AND OTHER EXCAVATION IN THIS CONTRACT AND/OR FROM THE ON SITE BORROW AREAS AS DESIGNATED BY THE CONTRACTING OFFICER'S REPRESENTATIVE.
  - BACKFILL MATERIALS INCLUDE MATERIAL THAT IS FREE OF DEBRIS, ROOTS, ORGANIC MATTER, REFUSE, CINDERS, FROZEN MATTER AND ALSO FREE OF ROCK WITH A DIMENSION GREATER THAN 2 INCHES.
- COMPACTION-
  - PLACE BACKFILL MATERIAL IN LEVEL LAYERS 3 TO 6 INCHES.
  - USE HAND METHODS TO A HORIZONTAL PLANE 6 INCHES ABOVE TOP OF CONDUIT.
  - USE APPROVED MECHANICAL METHODS WHERE HAND BACKFILL IS NOT REQUIRED.
  - BACKFILL COMPACTION SHALL BE 95% MOISTURE CONTENT SHALL BE -2 TO +3% OF OPTIMUM MOISTURE CONTENT.
- ROUTE LOW VOLTAGE CIRCUITS ABOVE MEDIUM VOLTAGE CIRCUITS UNLESS OTHERWISE NOTED ON ELECTRICAL PROFILES.
- PROVIDE WARNING TAPE, CENTERED ON DUCTBANK, 12" BELOW GRADE.

LOW VOLTAGE POWER DIRECT BURIED DUCTS

SECTION

NOT TO SCALE

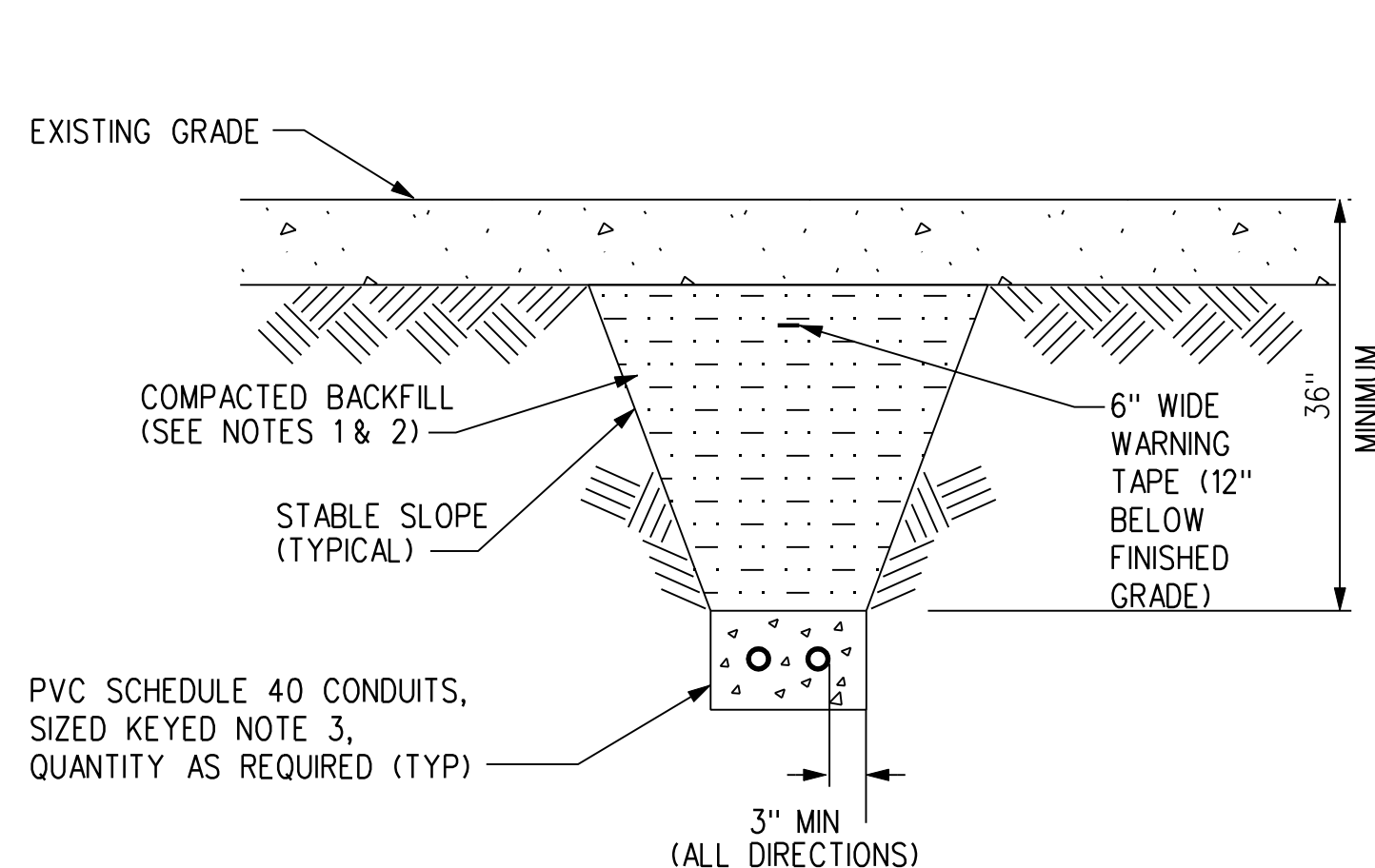
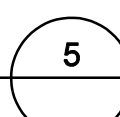


NOTE:  
1. FOR FIXTURE TYPES: H2 OR H3

TYPICAL PARKING LOT LIGHT POLE FOUNDATION DETAIL

DETAIL

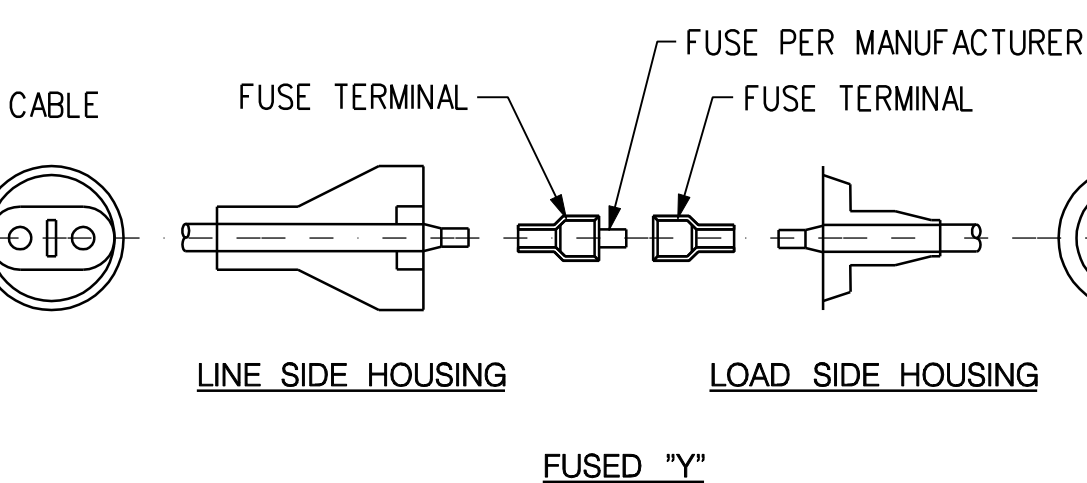
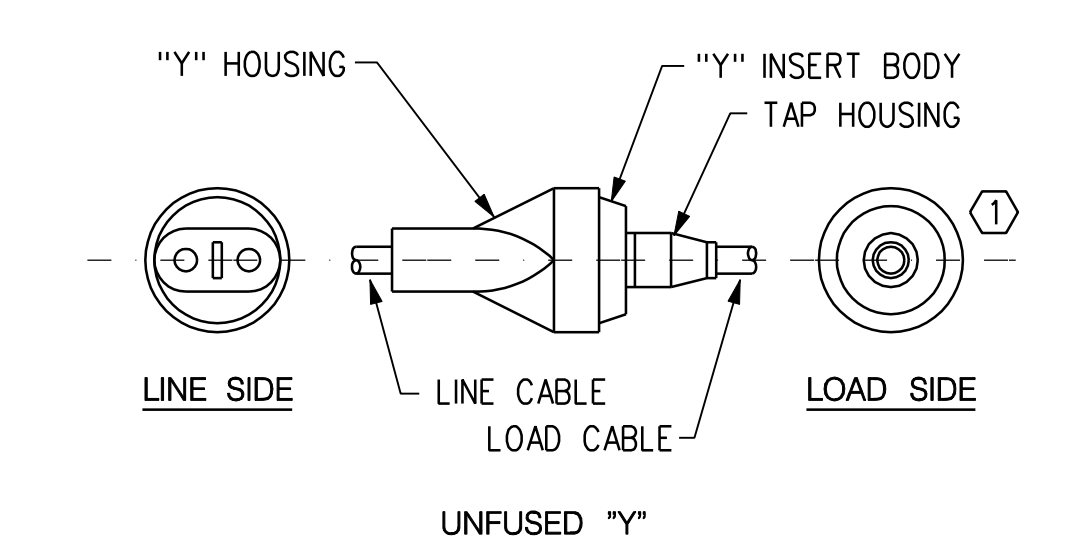
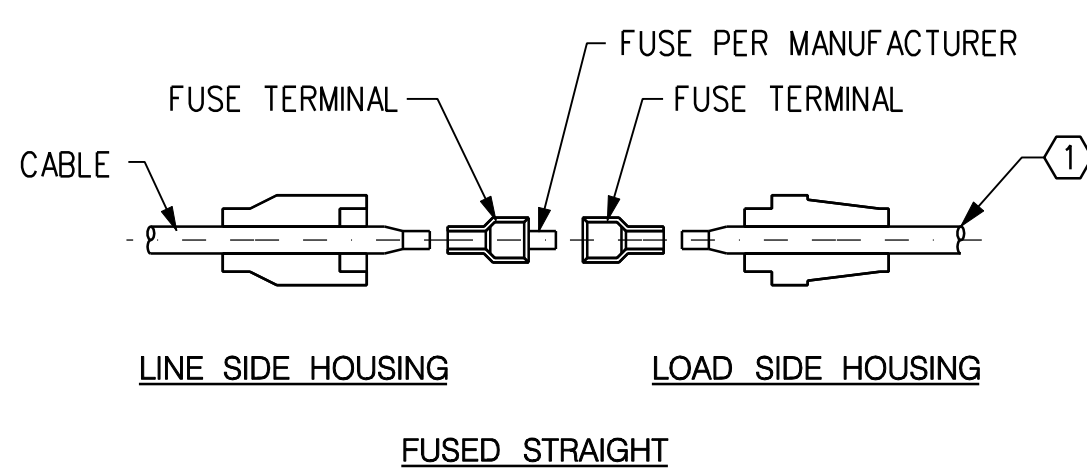
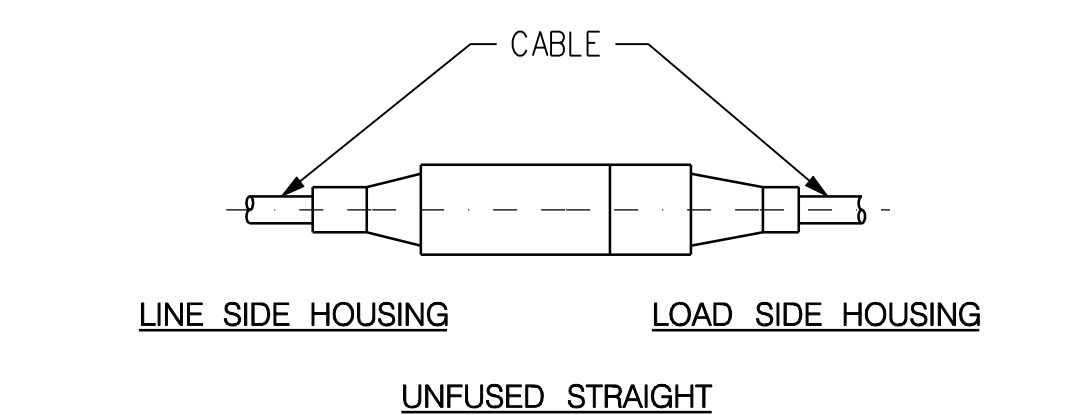
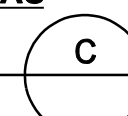
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LOW VOLTAGE POWER CONCRETE ENCASED DUCTS BELOW VEHICULAR TRAFFIC AREAS

SECTION

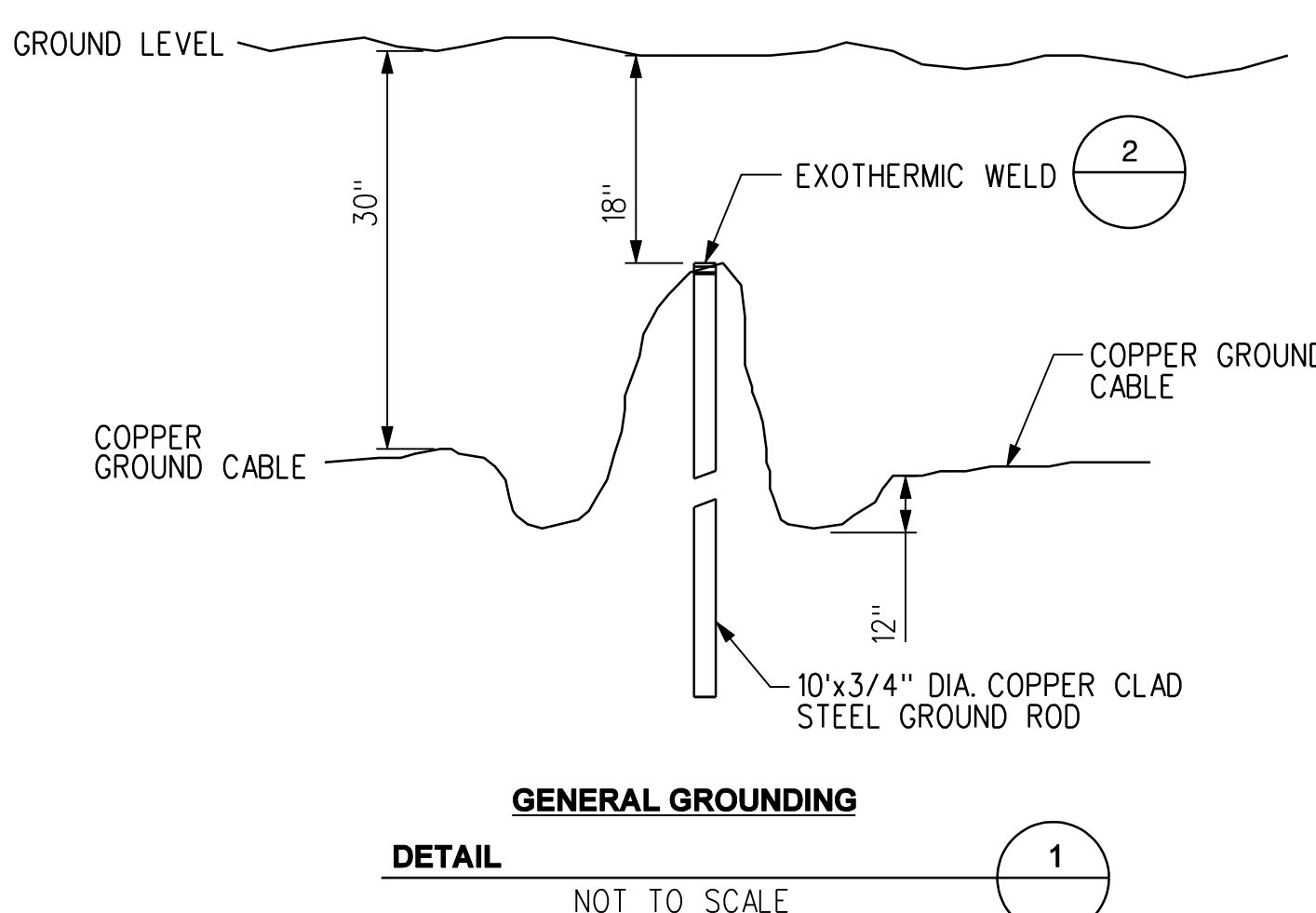
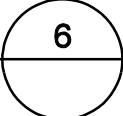
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ELECTRICAL CONNECTOR KITS

DETAIL

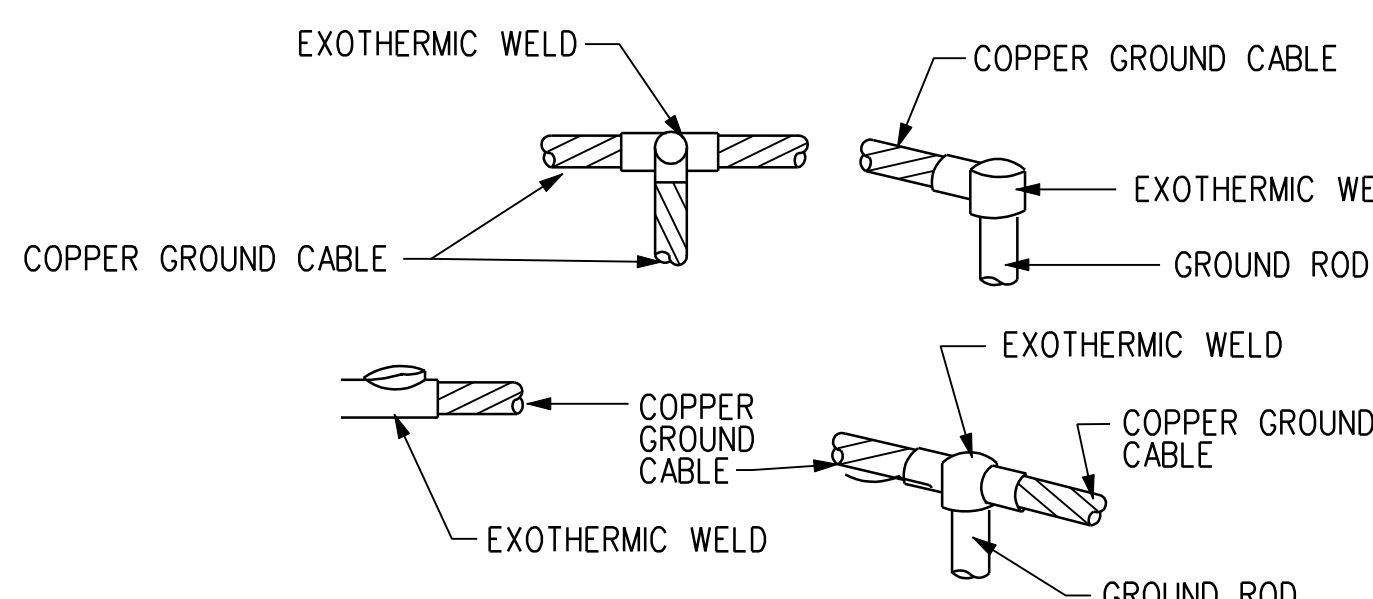
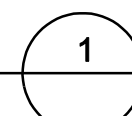
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GENERAL GROUNDING

DETAIL

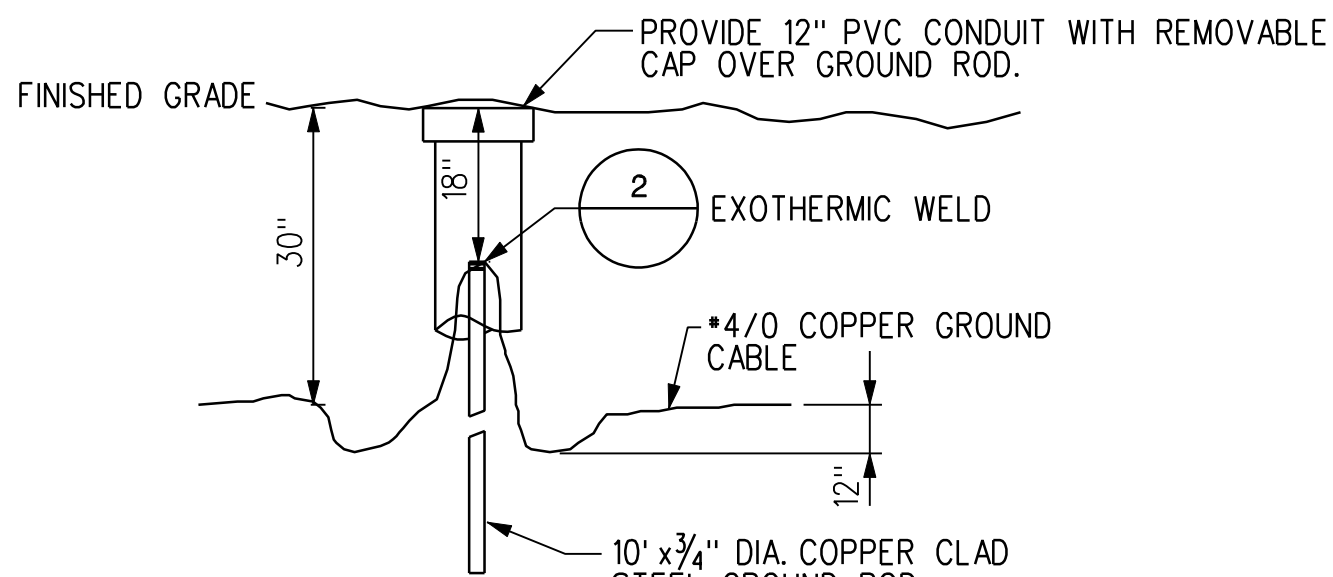
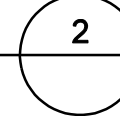
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TYPICAL EXOTHERMIC WELDS

DETAIL

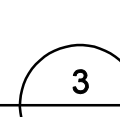
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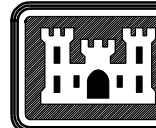
TYPICAL GENERAL GROUNDING ROD DETAIL

DETAIL

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| SYMBOL | DESCRIPTION | DATE | APPR |
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|--|----------------------|---|------------------------------|
| <div><div>51121</div></div> |                      | <div><div>US Army Corps<br/>of Engineers</div></div> |                              |
| DESIGNED BY:<br>B. POOLE   |                      | FORT SILL ARMY POST<br>OKLAHOMA   |                              |
| DRAWN BY:<br>P. DAMICO   |                      | PDC: 65299  | FY: 10                       |
| REVIEWED BY:<br>T. PARADEIS  |                      | CENTRAL ISSUE FACILITY<br>(CIF)   |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC.                       |                      | ELECTRICAL UTILITIES DETAILS (2 OF 3)   |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:           | CONTRACT DATE:  | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10UBE-502  |                      | RFP NO.<br>W912BV--   |                              |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>33 OF<br>41 | CONTRACT NO.<br>W912BV--  | E502                         |

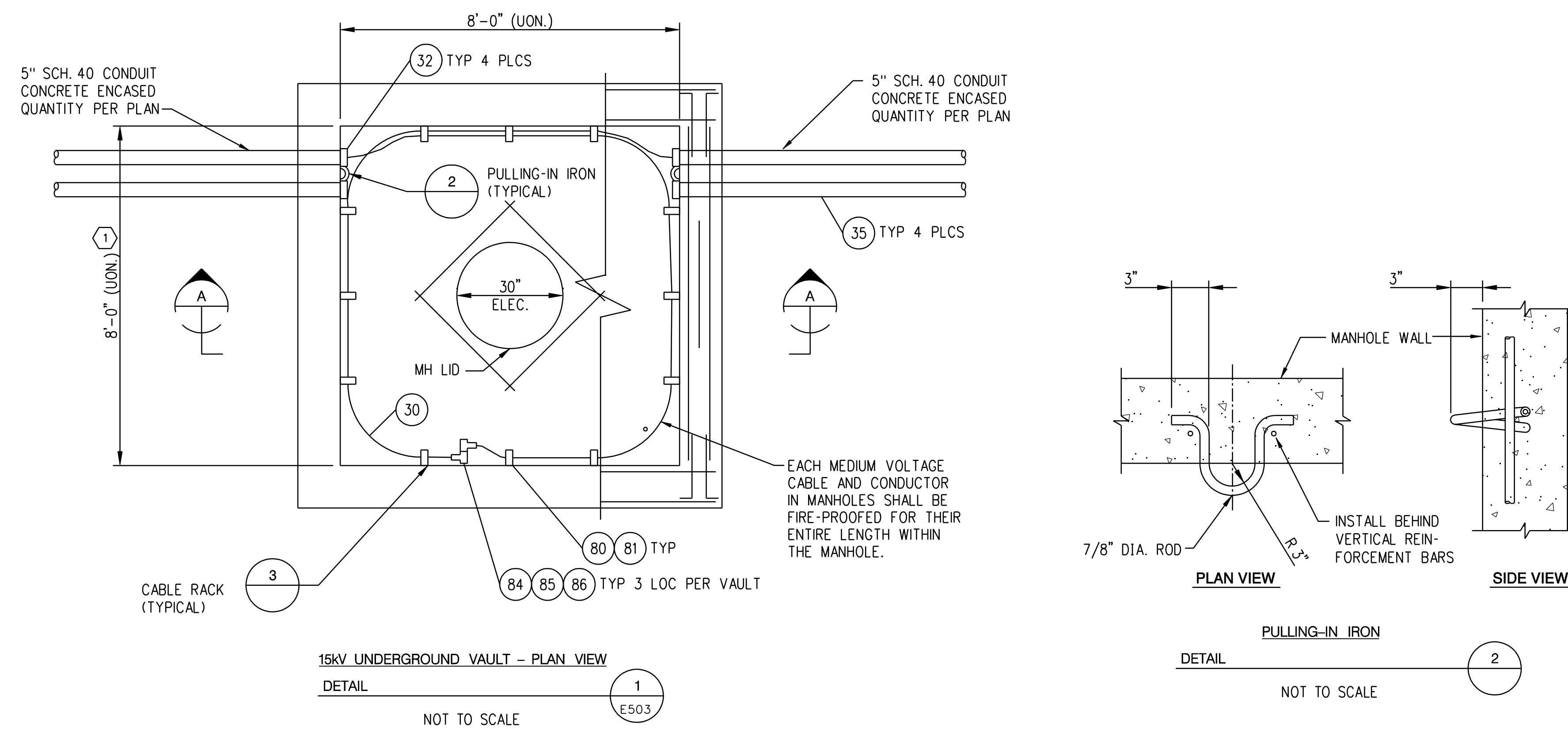
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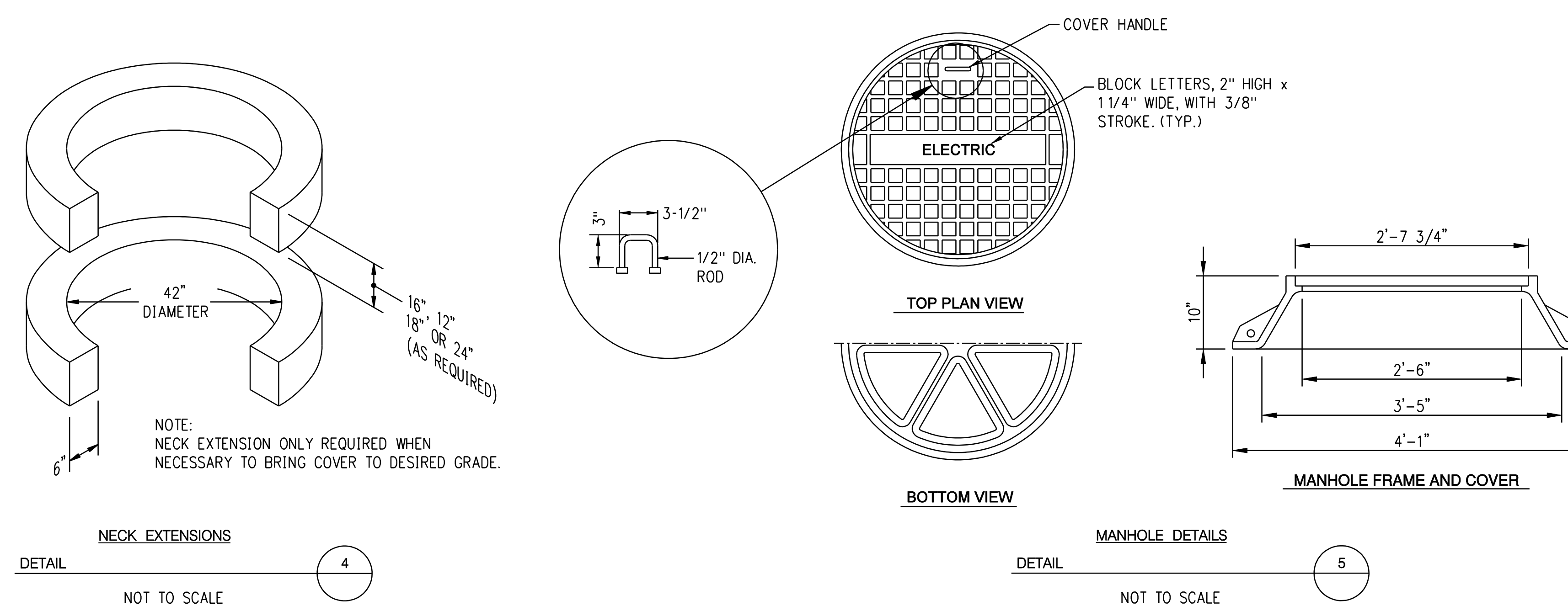
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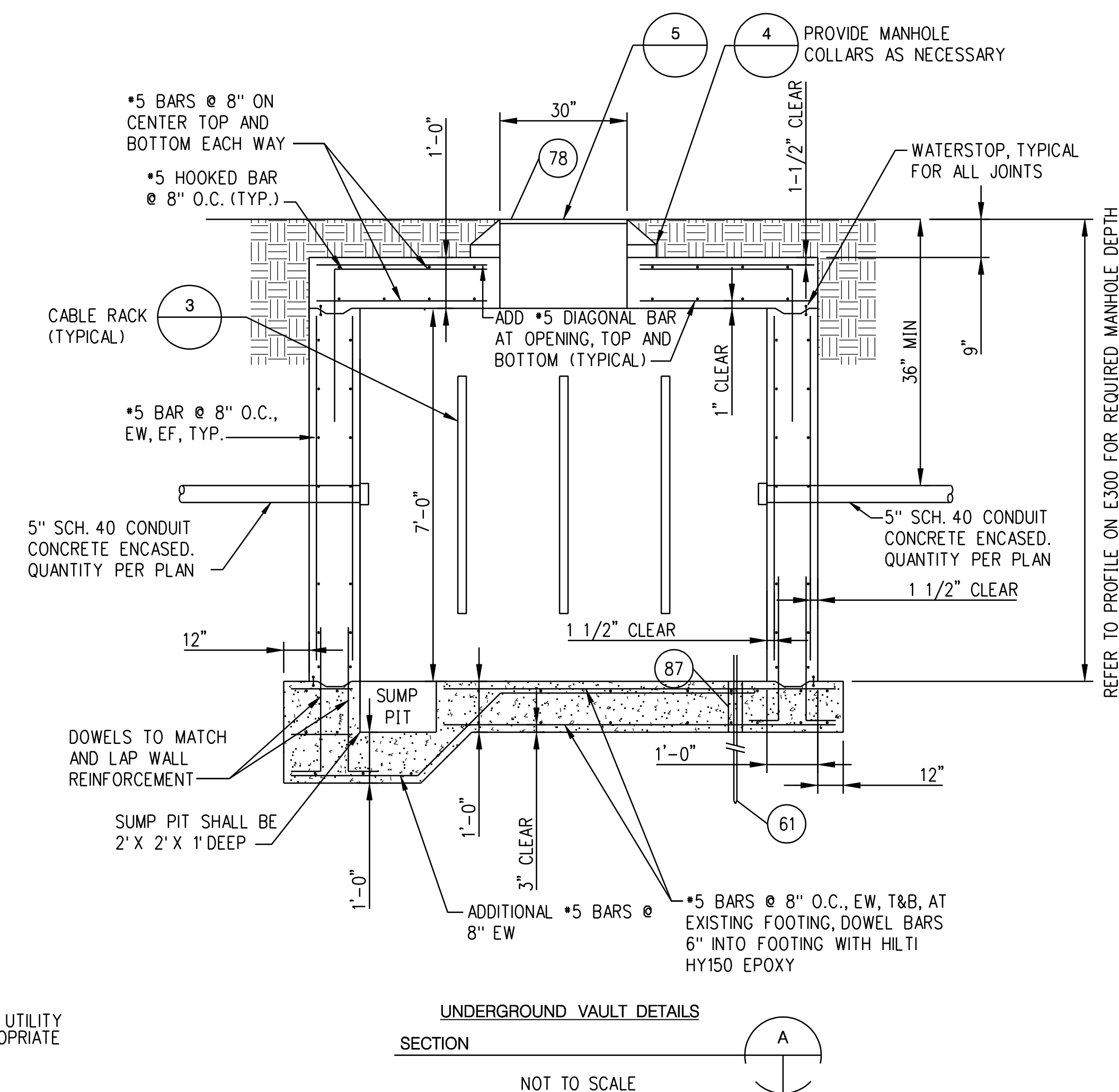
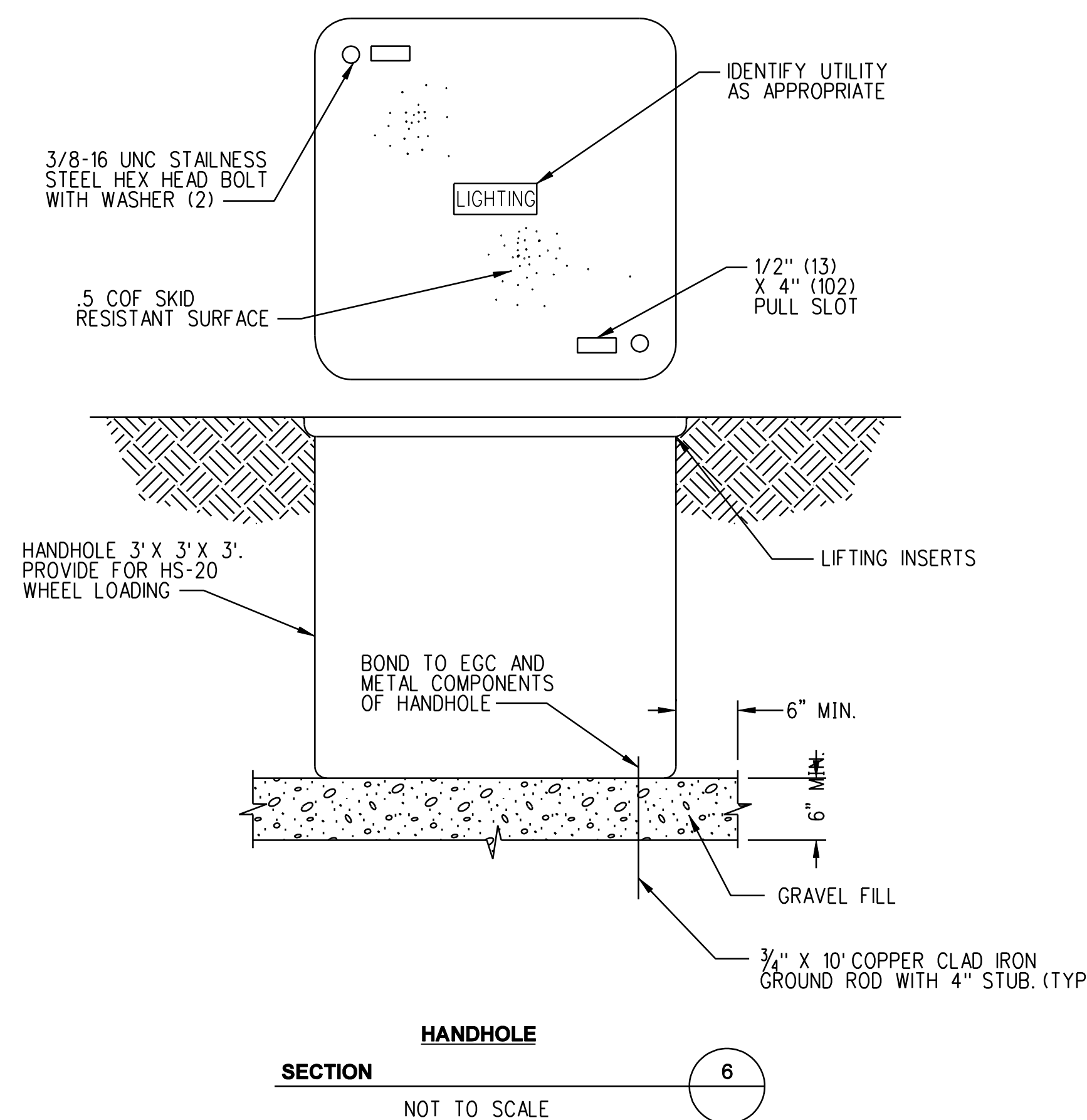
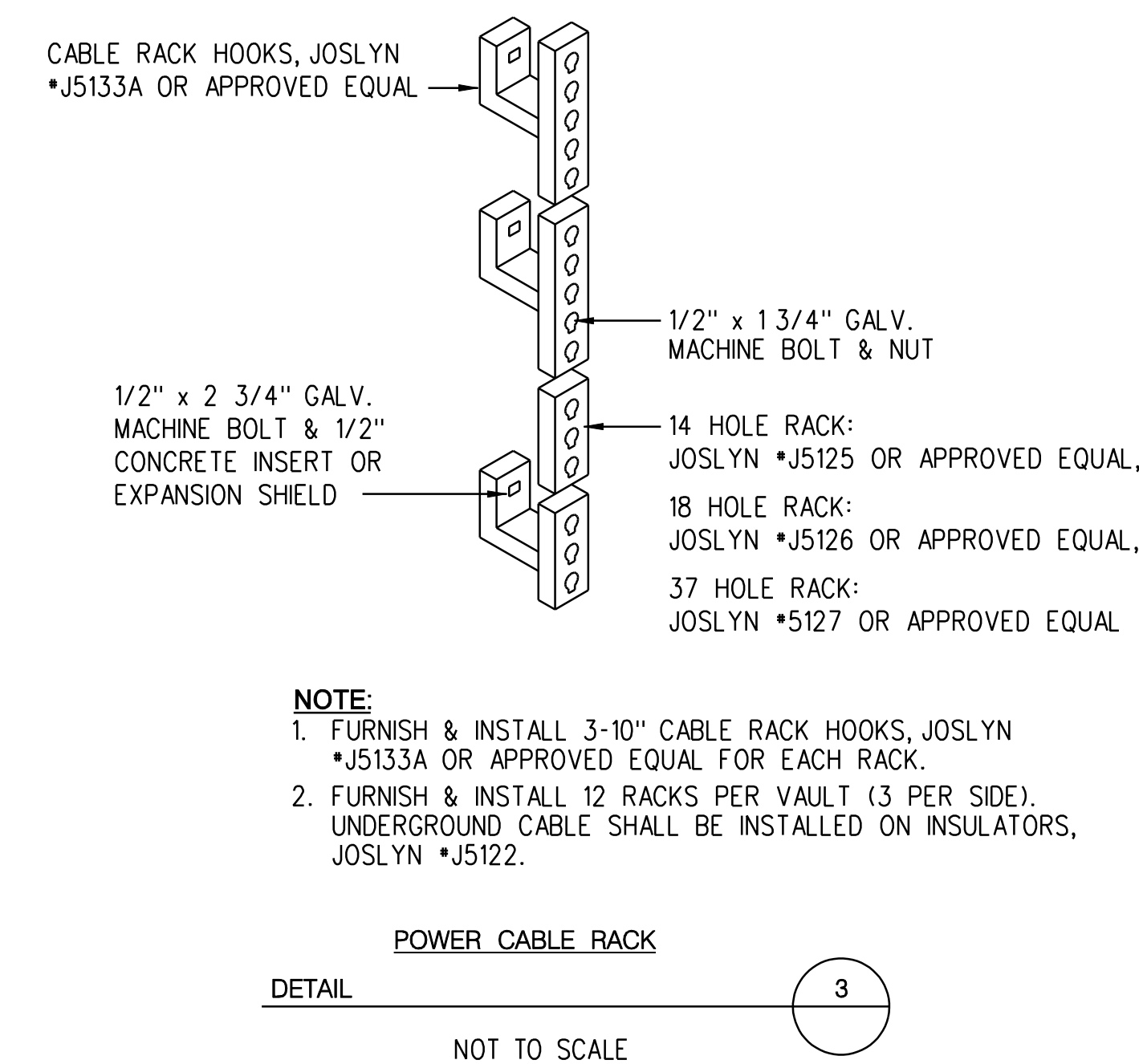
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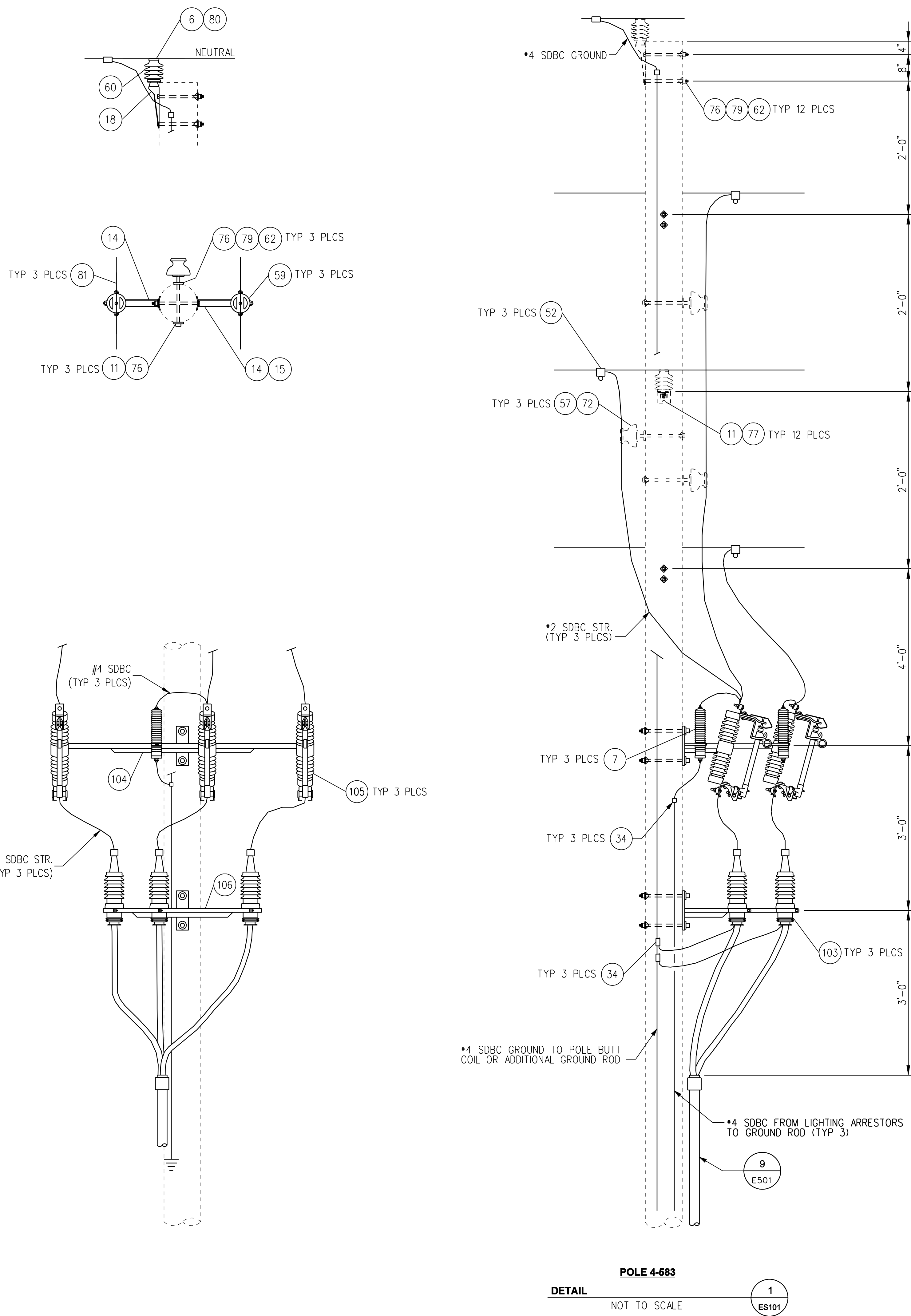


A



| ALL UNDERGROUND UTILITY VAULTS AND MATERIALS |  |         |                            |                        |
|--|--|---------|----------------------------|------------------------|
| ITEM NO.                                     | DESCRIPTION                            | MANUF.  | PROD. NO.                  | COMMENTS               |
| 30   | Conductor, #2 Cu, 15kV                 | Okonite | 140-23-3060 (3-PHASE)      |                        |
| 32   | Conduit, 5" Bell End                   | Carlton | 140-23-3060 (SINGLE PHASE) |                        |
| 35   | Conduit, 5" Sch. 40 PVC                | Carlton | CE297P                     |                        |
| 61   | Ground Rod, 3/4"x10' Copper Clad Steel | Joslyn  | 49016-020                  |                        |
| 78   | Manhole 8' X 8' X 7'                   | -       | J8350                      |                        |
| 80   | Rack, Underground Cable Insulator      | Joslyn  | J-5155                     | Unless otherwise noted |
| 81   | Rack, Underground Cable w/Hooks        | Joslyn  | J-5133A                    |                        |
| 84   | Splice, 15kV, Cable Adapters           | Hubbell | 625CAN                     |                        |
| 85   | Splice, 15kV, Connector, Compression   | Hubbell | 625LUG38                   | See specifications     |
| 86   | Splice, 15kV, T-Body Kit               | Hubbell | Modular Splice Kit 625L2T  |                        |
| 87   | PVC Sleeve                             |         |                            |                        |

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| POLE 4-583 |   | Num. of Details: 1 |                    |          |      |          |
|------------|---|--------------------|--------------------|----------|------|----------|
| ITEM NO.   | DESCRIPTION   | MANUF.             | PROD. NO.          | QUANTITY | ITEM | COMMENTS |
| 6          | Armor Rod, 4/0 ACSR (60")                           | Preformed L.P.     | AR-0124            | 1        | EA   |          |
| 7          | Arrestor 10kV Distribution Class                    | Maclean Power      | ZNP010             | 3        | EA   |          |
| 11         | Bolt, Machine w/SQ. Nut 5/8" X Req'd Length         | Chance             | 8800 Series        | 15       | EA   |          |
| 14         | Bracket, 12" (Armless Narrow Profile)               | Flagg              | P613D              | 2        | EA   |          |
| 15         | Bracket, 18" (Armless Narrow Profile)               | Flagg              | P619D              | 1        | EA   |          |
| 18         | Bracket, Pole Top                                   | Flagg              | P526               | 1        | EA   |          |
| 34         | Connector, Compression, #4 Cu. To #4 Cu.            | Homac              | CC44               | 6        | EA   |          |
| 52         | Hotline Clamp                                       | Maclean Power      | C1530              | 3        | EA   |          |
| 57         | Insulator, Pin Type F-Neck                          | Lapp               | 7081R-70           | 3        | EA   |          |
| 59         | Insulator, Post Type, F-Neck, 1-3/4" Stud           | Lapp               | 4320-P-70          | 3        | EA   |          |
| 60         | Insulator, Post Type, F-Neck, 1-3/4" Stud (Neutral) | Lapp               | 4315-P-70          | 1        | EA   |          |
| 62         | Locknut, 5/8" SQ.                                   | Chance             | 3512               | 15       | EA   |          |
| 72         | Stud, Thimble Pin Adapter                           | Chance             | 4258               | 3        | EA   |          |
| 76         | Washer, 3" X 3" X 1/4" SQ. Curved For 5/8" Bolt     | Chance             | 682312             | 18       | EA   |          |
| 77         | Washer, 5/8" Round                                  | Chance             | 6805               | 12       | EA   |          |
| 79         | Washer, Lock, 5/8" Double Coil Spring               | Chance             | C205-0186          | 15       | EA   |          |
| 80         | Wire Tie, #4 S.D. Aluminum                          | -                  | -                  | 4        | LF   |          |
| 81         | Wire Tie, #4 S.D. Cu.                               | -                  | -                  | 24       | LF   |          |
| 103        | Termination, #2 UD CU                               | Maclean Power      | 16THG-GA220-0X     | 3        | EA   |          |
| 104        | Bracket, Arrestor & Cut Out                         | Aluma-Form         | R3CA-51839         | 1        | EA   |          |
| 105        | Fused Cutout, 15kV                                  | Cooper             | L4B1P1A            | 3        | EA   |          |
| 106        | Bracket, Termination                                | Aluma-Form         | TB-EMB-1-3PA-51033 | 1        | EA   |          |

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| SYMBOL  | DESCRIPTION                     | DATE   | APPR                         |
|  51121 |                                 |  US Army Corps of Engineers |                              |
| DESIGNED BY:<br>B. POOLE  | FORT SILL ARMY POST<br>OKLAHOMA |  |                              |
| DRAWN BY:<br>P. DAMICO  | PDC: 65299                      | FY: 10   |                              |
| REVIEWED BY:<br>T. PARADEIS   | CENTRAL ISSUE FACILITY<br>(CIF) |  |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC.  | ELECTRICAL POLES 4-583 DETAILS  |  |                              |
| PLOT SCALE:<br>AS SHOWN   | DWG. CODE:                      | CONTRACT DATE:   | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFE-503.DGN   | RFP NO.<br>W912BV--             |  | E511                         |
| PLOT DATE:<br>XX-XXX-2009   | SHEET<br>35 OF 41               | CONTRACT NO.<br>W912BV--   |                              |

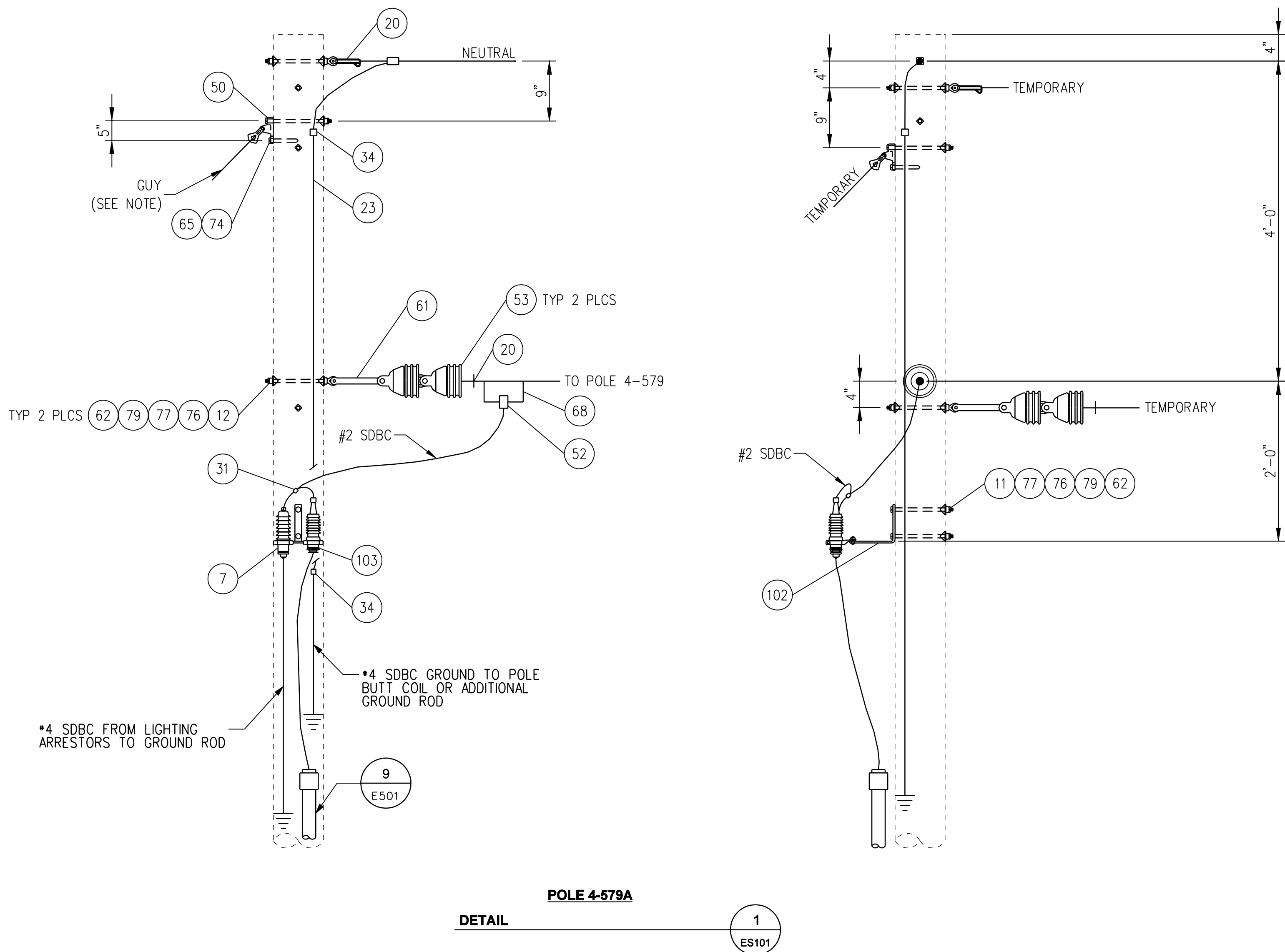


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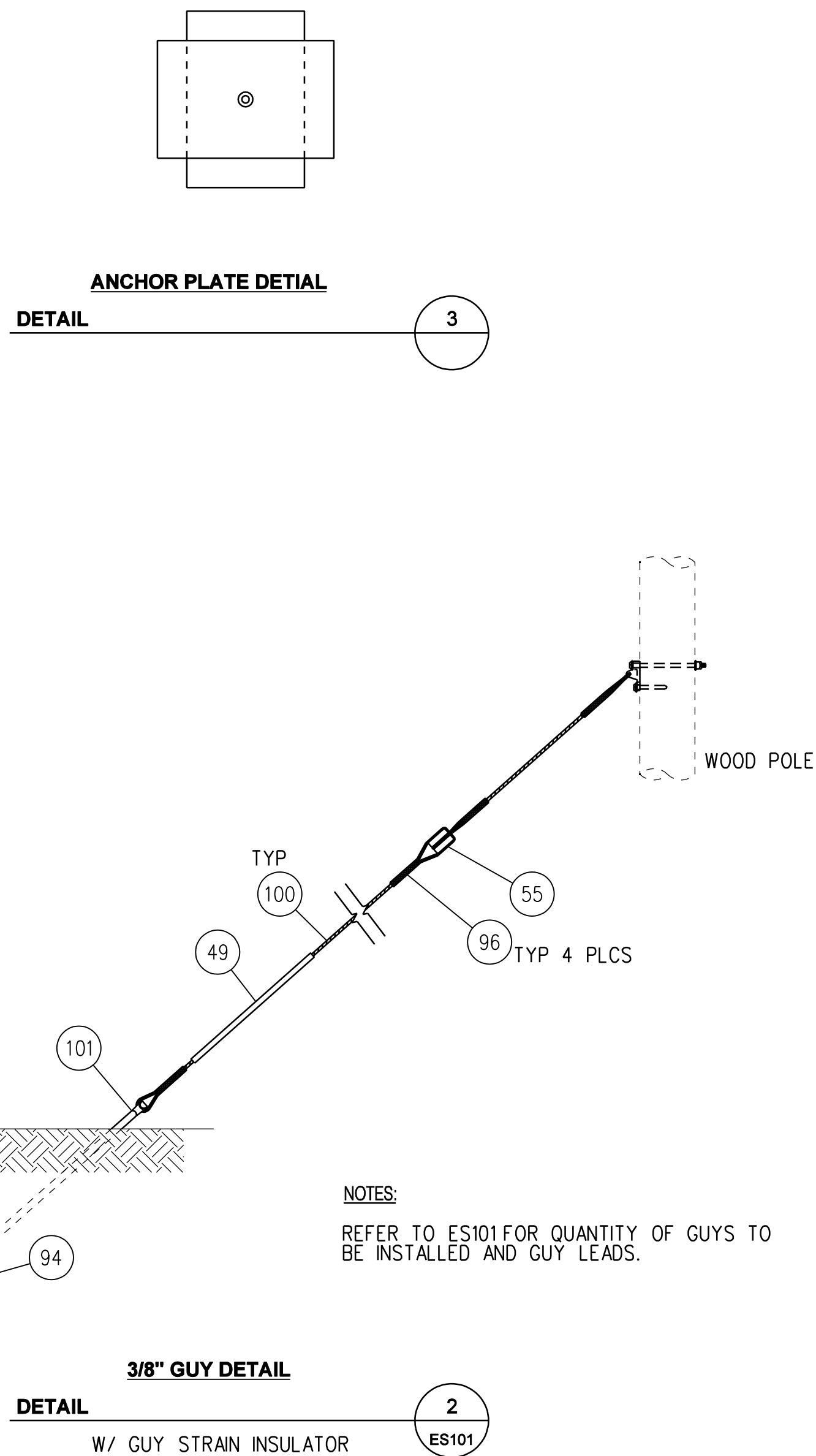
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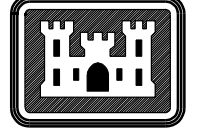


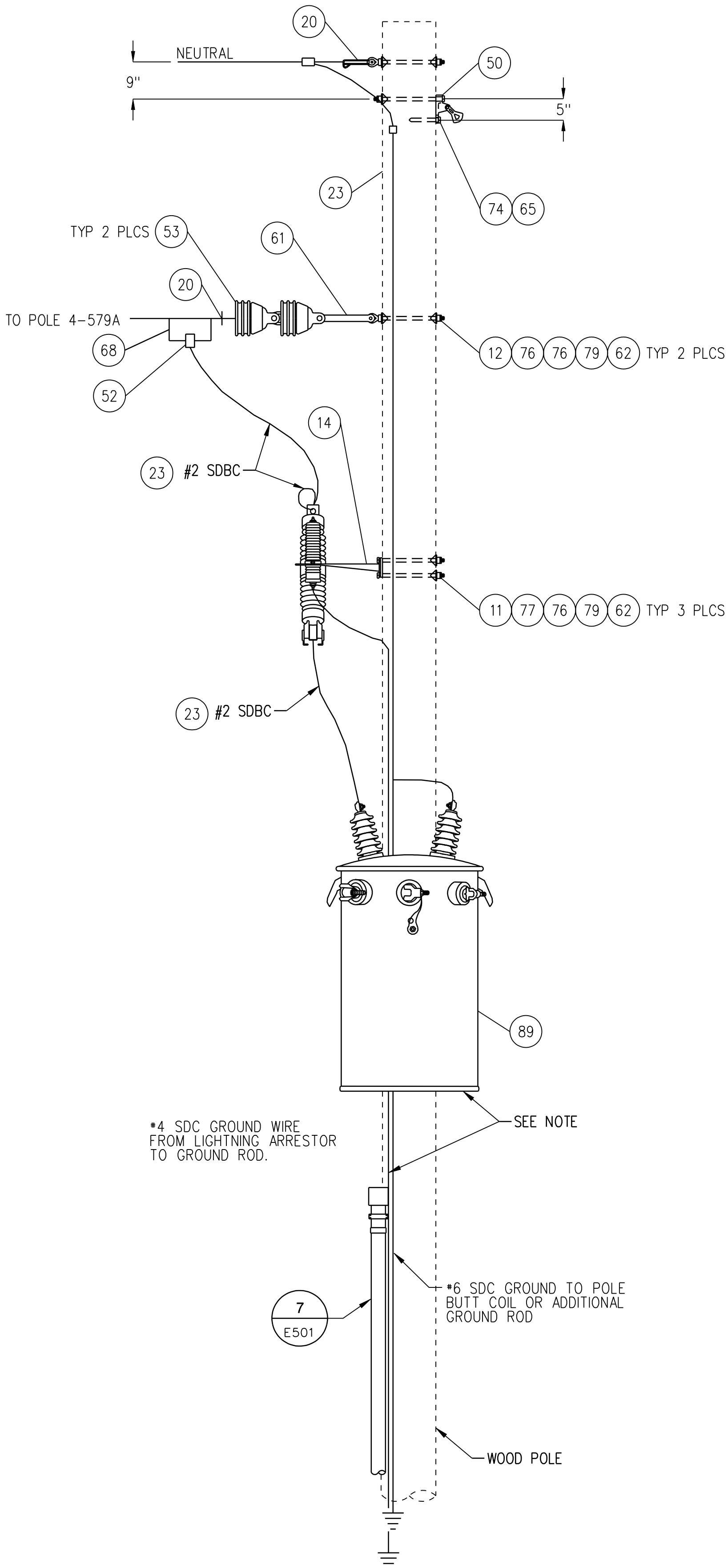
| POLE: 4-579A |   | Num. of Details: 1 |                |          |      |          |
|--------------|---|--------------------|----------------|----------|------|----------|
| ITEM NO.     | DESCRIPTION                                     | MANUF.             | PROD. NO.      | QUANTITY | ITEM | COMMENTS |
| 7            | Arrestor 10kV Distribution Class                | Maclean Power      | ZNP010         | 1        | EA   |          |
| 11           | Bolt, Machine w/SQ. Nut 5/8" X Req'd Length     | Chance             | 8800 Series    | 3        | EA   |          |
| 12           | Bolt, Oval Eye, 5/8" X Req'd Length             | Chance             | 2900 Series    | 2        | EA   |          |
| 20           | Clamp, Deadend Strain #2 - 556 Al.              | Anderson           | ADS-88-C       | 2        | EA   |          |
| 23           | Conductor, #4 S.D. Bare Copper                  | -                  | -              | -        | LF   |          |
| 31           | Connector, Compression, #2 Cu. To #2 Cu.        | Homac              | CC22           | 1        | EA   |          |
| 34           | Connector, Compression, #4 Cu. To #4 Cu.        | Homac              | CC44           | 2        | EA   |          |
| 50           | Guy, Hook, Combination Type                     | Joslyn             | P-345          | 1        | EA   |          |
| 52           | Hotline Clamp                                   | Maclean Power      | C1530          | 1        | EA   |          |
| 53           | Insulator, Deadend Bell                         | Lapp               | 6815-70        | 2        | EA   |          |
| 61           | Link, Extension (20")                           | Joslyn             | J6659          | 1        | EA   |          |
| 62           | Locknut, 5/8" SQ.                               | Chance             | 3512           | 5        | EA   |          |
| 65           | Screw, Lag, 1/2" X 4"                           | Joslyn             | J8784          | 1        | EA   |          |
| 68           | Stirrup, #2 ACSR                                | Maclean Power      | HLS-2/0-E      | 1        | EA   |          |
| 74           | Washer, 1/2" Round                              | Joslyn             | J1086          | 1        | EA   |          |
| 76           | Washer, 3" X 3" X 1/4" SQ. Curved For 5/8" Bolt | Chance             | 682312         | 7        | EA   |          |
| 77           | Washer, 5/8" Round                              | Chance             | 6805           | 3        | EA   |          |
| 79           | Washer, Lock, 5/8" Double Coil Spring           | Chance             | C205-0186      | 5        | EA   |          |
| 102          | Bracket, Arrestor / Underground Termination     | Chance             | C206-0299      | 1        | EA   |          |
| 103          | Termination, #2 UD CU                           | Maclean Power      | 16THG-GA220-0X | 1        | EA   |          |



| SINGLE ANCHOR GUY DETAIL - TYPE 2 |  |                |           | NUM. OF DETAILS: 2 AND 3 |      |          |
|-----------------------------------|--|----------------|-----------|--------------------------|------|----------|
| ITEM NO.                          | DESCRIPTION                            | MANUF.         | PROD. NO. | QUANTITY                 | ITEM | COMMENTS |
| 49                                | GUARD, GUY, 8' YELLOW, HELICAL PIGTAIL | JOSLYN         | J26520-8Y | 1                        | EA   |          |
| 55                                | INSULATOR, GUY STRAIN, CLASS 54-3      | JOSLYN         | L506      | 1                        | EA   |          |
| 94                                | ANCHOR, 20" GALVANIZED CROSS PLATE     | JOSLYN         | J3520G    | 1                        | EA   |          |
| 96                                | GRIP GUY, PREFORM (3/8")               | PREFORMED L.P. | GDE1107   | 4                        | EA   |          |
| 100                               | GUY, WIRE 3/8" EHS 7 STR               | -              | -         | 60                       | LF   |          |
| 101                               | ANCHOR, ROD 3/4" X 8"                  | JOSLYN         | J7528     | 1                        | EA   |          |

| SYMBOL | DESCRIPTION | DATE | APPR |
|--------|-------------|------|------|
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|       |                     |  |                              |
| DESIGNED BY:<br><b>B. POOLE</b>  |                     | FORT SILL ARMY POST<br>OKLAHOMA   |                              |
| DRAWN BY:<br><b>P. DAMICO</b>  |                     | PDC: 65299 FY: 10   |                              |
| REVIEWED BY:<br><b>T. PARADEIS</b>   |                     | CENTRAL ISSUE FACILITY<br>(CIF)   |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC. |                     | ELECTRICAL POLE 4-579A DETAILS  |                              |
| PLOT SCALE:<br>AS SHOWN  | DWG. CODE:          | CONTRACT DATE:  | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS10CFE-512.DGN  | RFP NO.<br>W912BV-- | CONTRACT NO.<br>W912BV--  | <b>E512</b>                  |
| PLOT DATE:<br>XX - XXX - 2009  | SHEET<br>36 OF 41   |   |                              |

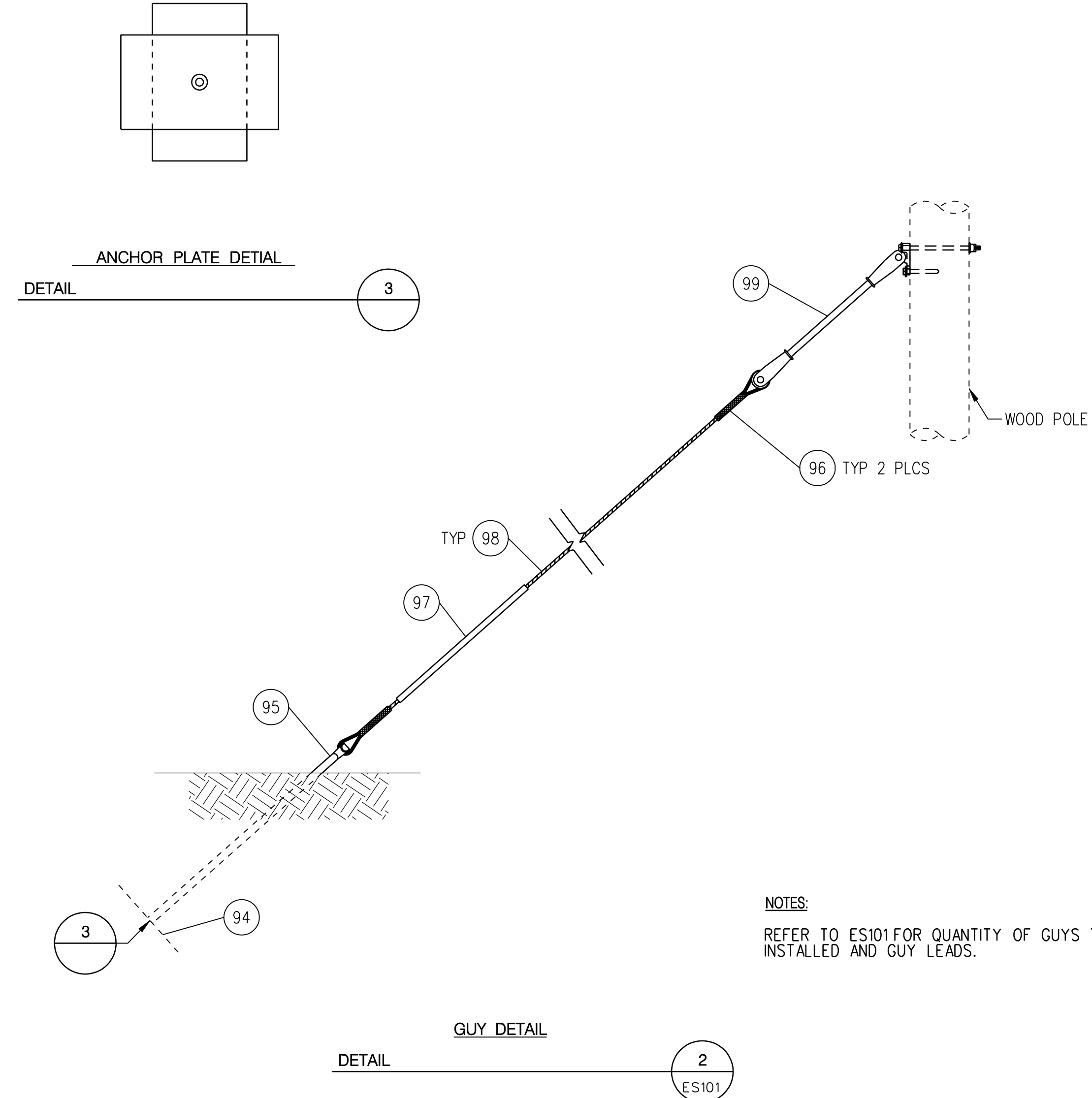


NOTES:  
PROVIDE AND INSTALL (1) 100kVA, 7.62kV - 120/240V TRANSFORMER. PROVIDE TRANSFORMER FUSING, SIZE AS REQUIRED.

7.6KV 1-PH DEADEND WXFMR  
DETAIL

1  
ES101

| POLE(S): T1 |   | NUM. OF DETAILS: 1 |               |          |      |                  |
|-------------|---|--------------------|---------------|----------|------|------------------|
| ITEM NO.    | DESCRIPTION                                     | MANUF.             | PROD. NO.     | QUANTITY | ITEM | COMMENTS         |
| 7           | ARRESTOR 10KV DISTRIBUTION CLASS                | JOSLYN             | 8151C0010J001 | 1        | EA   |                  |
| 11          | BOLT, MACHINE W/ SQ. NUT 5/8" X REQ'D LENGTH    | CHANCE             | 8800 SERIES   | 3        | EA   |                  |
| 12          | BOLT, OVAL EYE, 5/8" X REQ'D LENGTH             | CHANCE             | 2900 SERIES   | 2        | EA   |                  |
| 14          | BRACKET, 12" (ARMLESS NARROW PROFILE)           | FLAGG              | P613D         | 1        | EA   |                  |
| 20          | CLAMP, DEADEND STRAIN #2 - 556 AL               | ANDERSON           | ADS-88-C      | 2        | EA   |                  |
| 23          | CONDUCTOR, #4 S.D. BARE COPPER                  | -                  | -             | 12       | LF   |                  |
| 34          | CONNECTOR, COMPRESSION, #4 CU. TO #4 CU.        | HOMAC              | CC44          | 2        | EA   |                  |
| 44          | CUTOUT, 15KV, 100A                              | S&C                | 89021R10-D    | 1        | EA   |                  |
| 50          | GUY, HOOK, COMBINATION TYPE                     | JOSLYN             | P-345         | 1        | EA   |                  |
| 52          | HOTLINE CLAMP                                   | JOSLYN             | JS1520AA      | 1        | EA   |                  |
| 53          | INSULATOR, DEADEND BELL                         | LAPP               | 6815-70       | 2        | EA   |                  |
| 61          | LINK, EXTENSION (20')                           | JOSLYN             | J6659         | 1        | EA   |                  |
| 62          | LOCKNUT, 5/8" SQ.                               | CHANCE             | 3512          | 5        | EA   |                  |
| 65          | SCREW, LAG, 1/2" X 4"                           | JOSLYN             | J8784         | 1        | EA   |                  |
| 68          | STIRRUP, #2 ACSR                                | MACLEAN POWER      | HLS-2/0-E     | 1        | EA   |                  |
| 74          | WASHER, 1/2" ROUND                              | JOSLYN             | J1086         | 2        | EA   |                  |
| 76          | WASHER, 3" X 3" X 1/4" SQ. CURVED FOR 5/8" BOLT | CHANCE             | 682312        | 5        | EA   |                  |
| 77          | WASHER, 5/8" ROUND                              | CHANCE             | 6805          | 4        | EA   |                  |
| 79          | WASHER, LOCK 5/8" DOUBLE COIL SPRING            | CHANCE             | C205-0186     | 5        | EA   |                  |
| 89          | TRANSFORMER, 100KVA                             | -                  | -             | 1        | EA   | 7.6KV - 120/240V |
| 90          | BOLT, MACHINE W/SQ. NUT 3/4" X REQ'D LENGTH     | CHANCE             | 8900 SERIES   | 2        | EA   |                  |
| 91          | LOCKNUT, 3/4" SQ.                               | CHANCE             | 3513          | 2        | EA   |                  |
| 92          | WASHER, 3" X 3" X 1/4" SQ. CURVED FOR 3/4" BOLT | CHANCE             | 682212        | 2        | EA   |                  |
| 93          | WASHER, LOCK, 3/4" DOUBLE COIL SPRING           | CHANCE             | C2050187      | 2        | EA   |                  |



NOTES:  
REFER TO ES101 FOR QUANTITY OF GUYS TO BE INSTALLED AND GUY LEADS.

SINGLE ANCHOR GUY DETAIL - TYPE 3  
DETAIL

2  
ES101

| SINGLE ANCHOR GUY DETAIL - TYPE 3 |                                    |             |          |           |          |      |
|-----------------------------------|------------------------------------|-------------|----------|-----------|----------|------|
| ITEM NO.                          |                                    | DESCRIPTION | MANUF.   | PROD. NO. | QUANTITY | ITEM |
| 94                                | ANCHOR, 20" GALVANIZED CROSS PLATE | JOSLYN      | J3520G   | J7418     | 1        | EA   |
| 95                                | ANCHOR, ROD 5/8" X 8"              | JOSLYN      | J7418    | GDE1107   | 2        | EA   |
| 96                                | GRIP GUY, PREFORM (3/8")           | JOSLYN      | J5718    | -         | 1        | EA   |
| 97                                | GUY GUARD 3/8"                     | -           | -        | -         | 60       | LF   |
| 99                                | INSULATOR, FIBERGLASS              | JOSLYN      | 150-78NT | -         | 1        | EA   |

|  |  |                                 |                              |
|--|--|---------------------------------|------------------------------|
| DESIGNED BY:<br>B. POOLE   |  | FORT SILL ARMY POST<br>OKLAHOMA |                              |
| DRAWN BY:<br>P. DAMICO   |  | PDC: 65299                      |                              |
| REVIEWED BY:<br>T. PARADEIS  |  | FY: 10                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC. |  | CENTRAL ISSUE FACILITY<br>(CIF) |                              |
| PLOT SCALE:<br>AS SHOWN  |  | DWG. CODE:                      | CONTRACT DATE:               |
| DESIGN FILE:<br>FS10CFE-513.DGN  |  | RFP NO.<br>W9128V--             | SHEET<br>REFERENCE<br>NUMBER |
| PLOT DATE:<br>XX - XXX - 2009  |  | SHEET<br>37 OF 41               | CONTRACT NO.<br>W9128V--     |
|  |  | E513                            |                              |

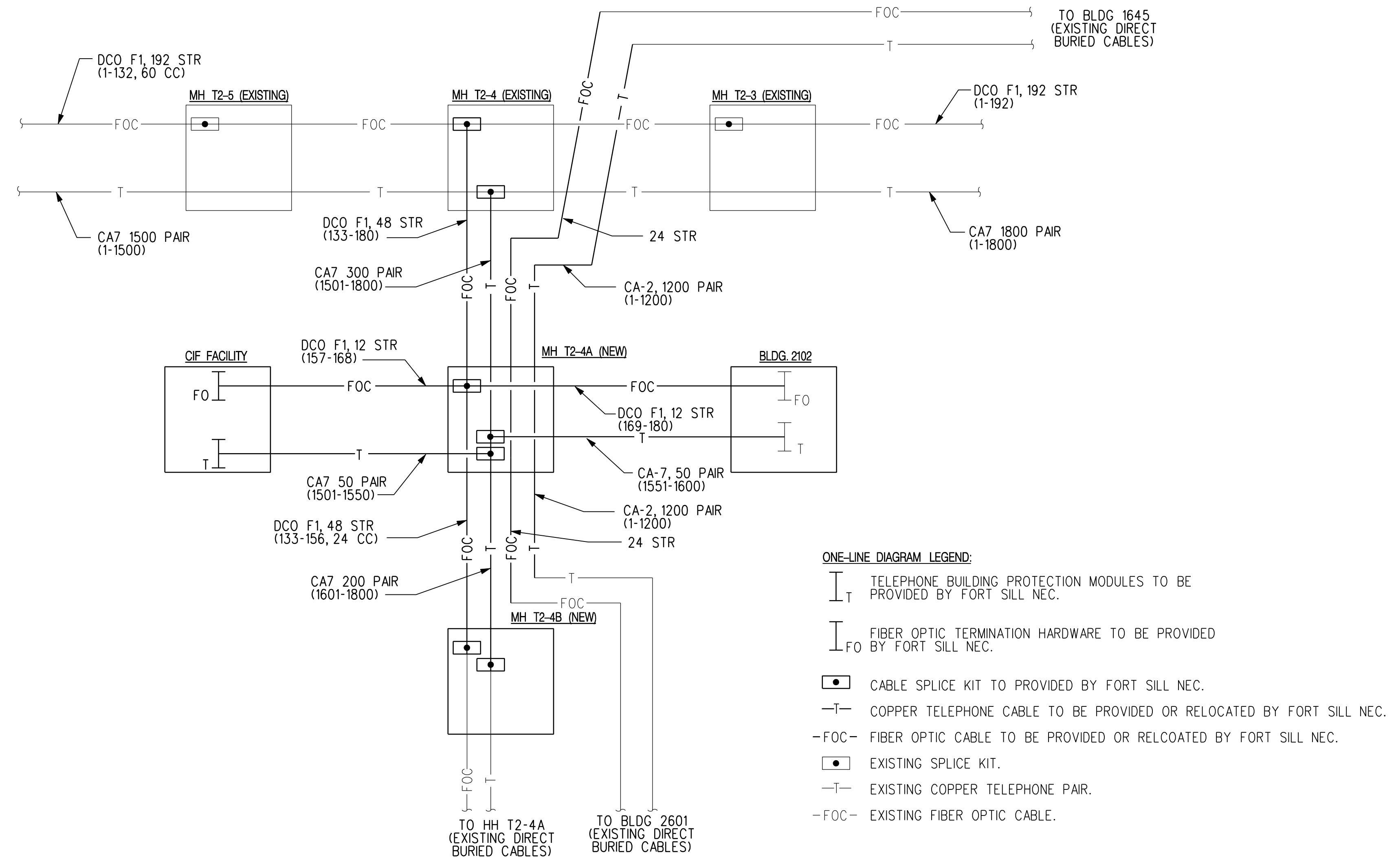


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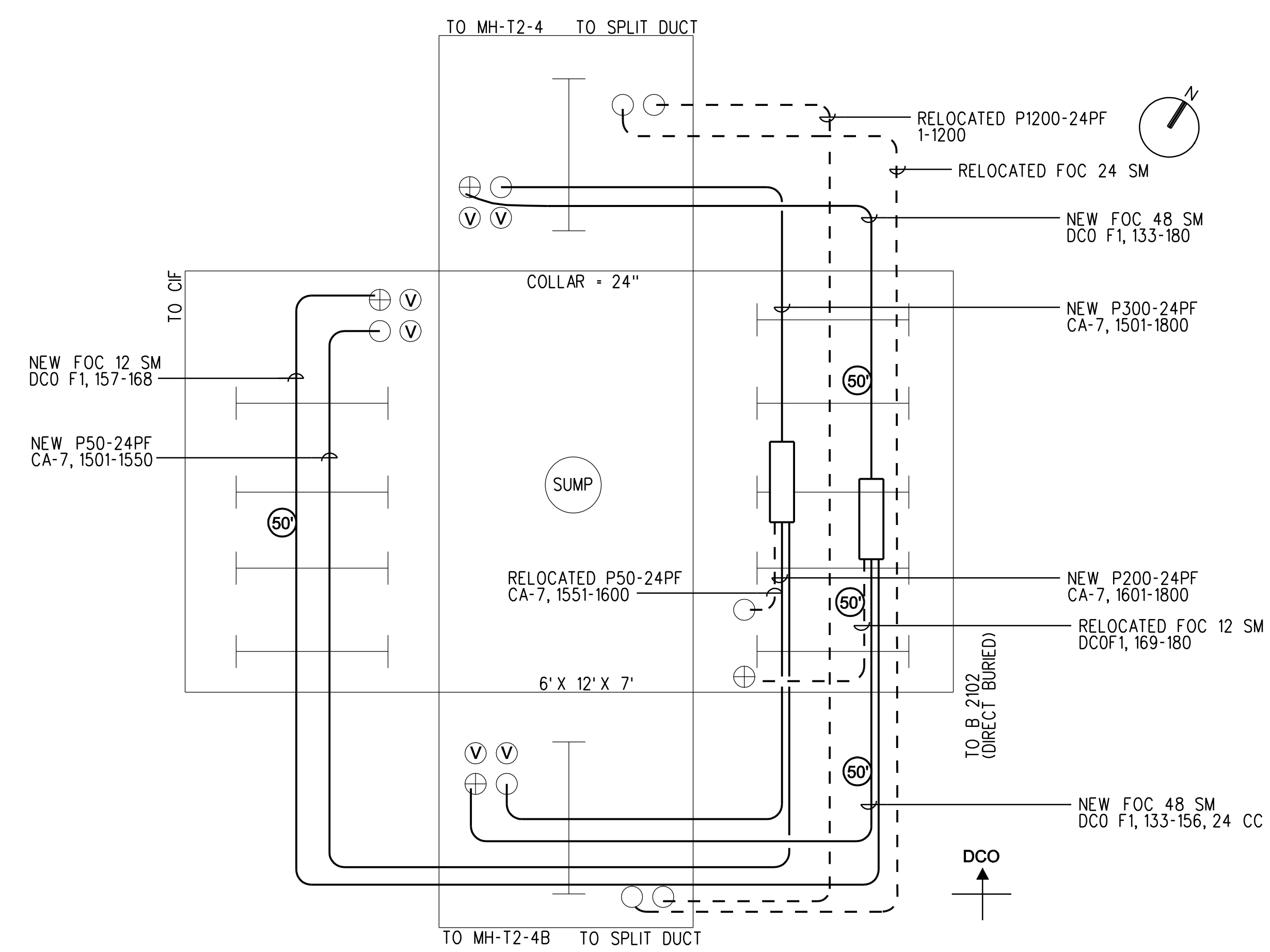
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B

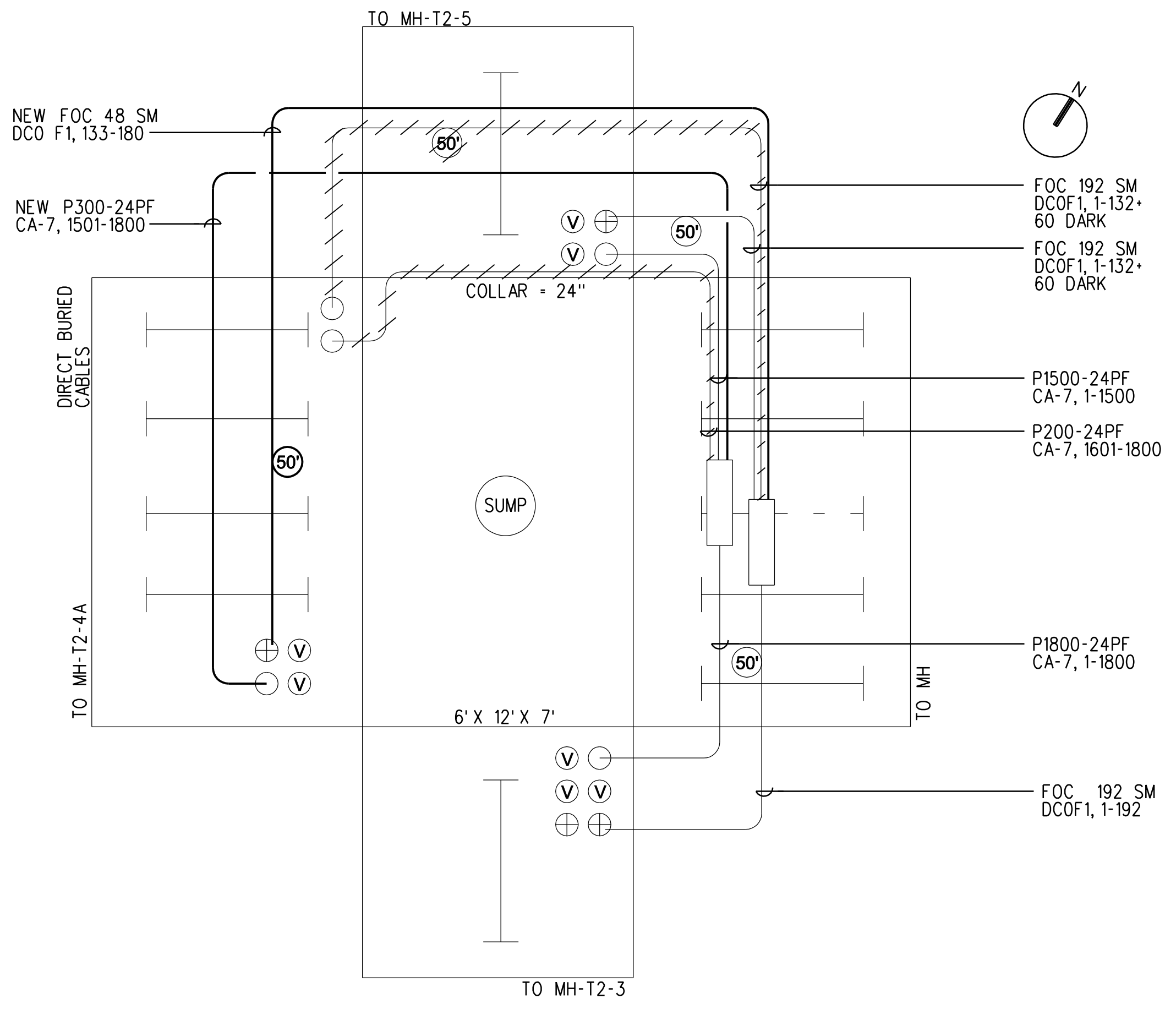
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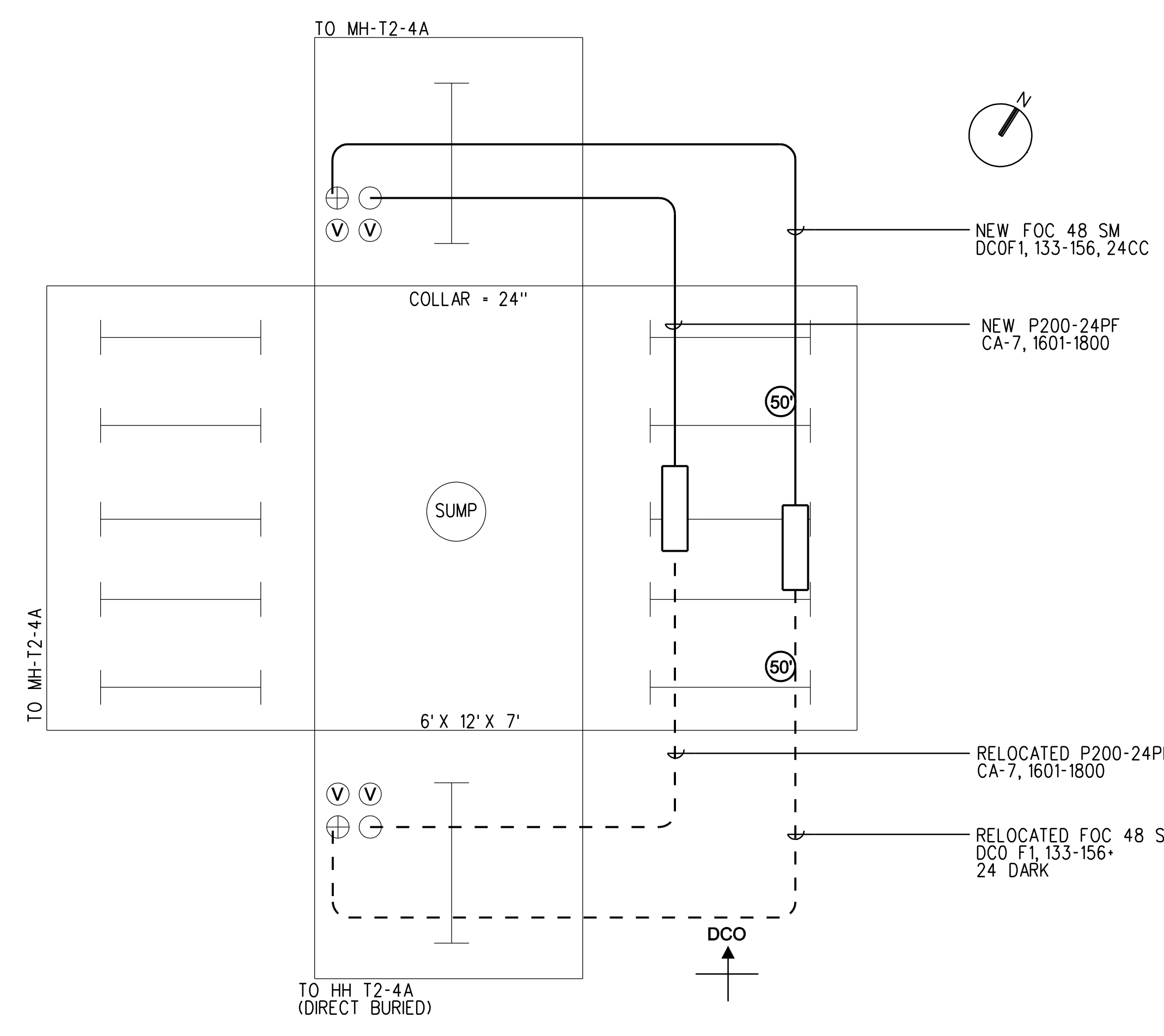
COMMUNICATIONS ONE-LINE DIAGRAM  
NOT TO SCALE



DETAIL MH-T2-4A (NEW)  
NOT TO SCALE



DETAIL MH-T2-4 (EXISTING CMH)  
NOT TO SCALE



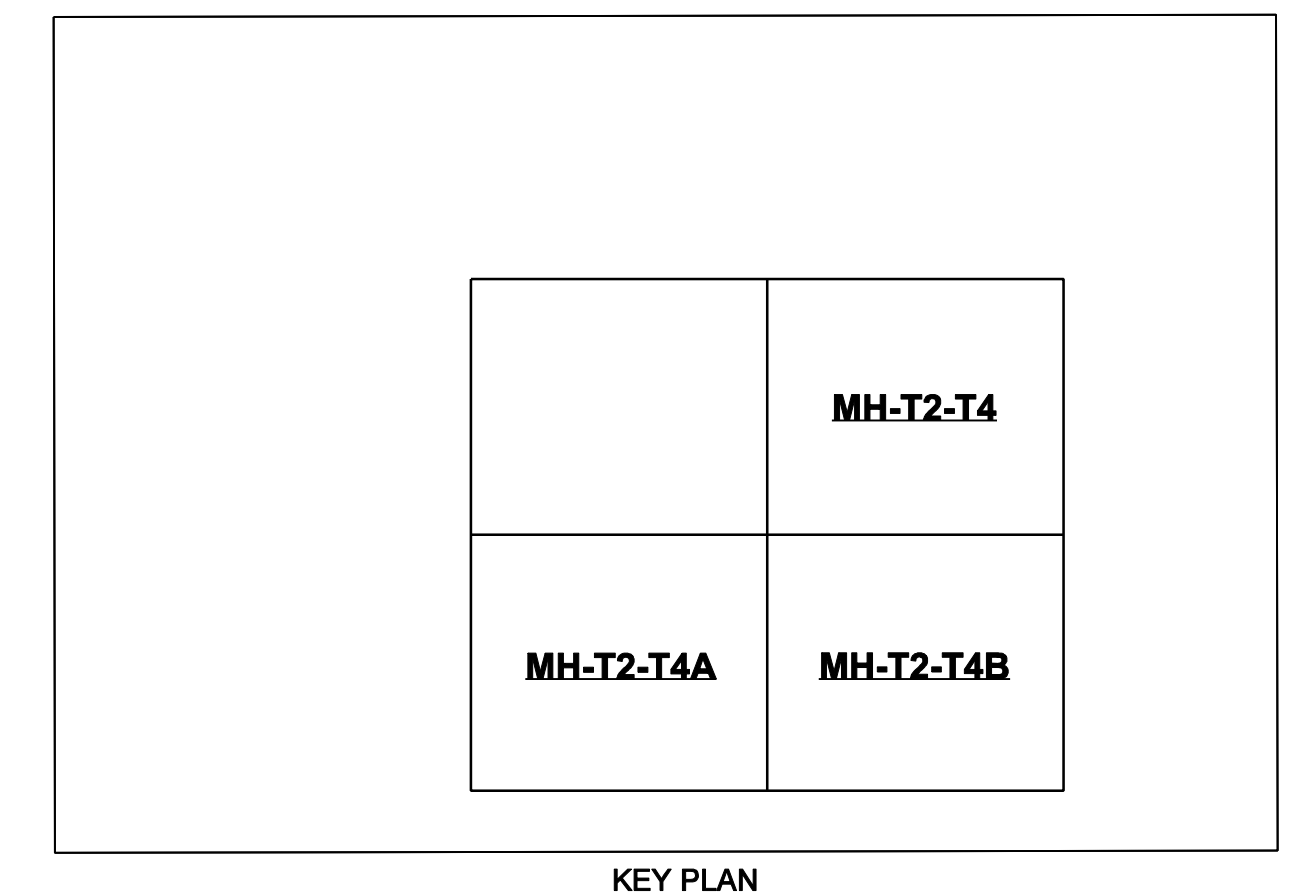
DETAIL MH-T2-4B (NEW)  
NOT TO SCALE


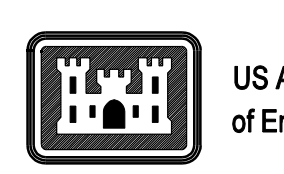
COMMUNICATION NOTES:

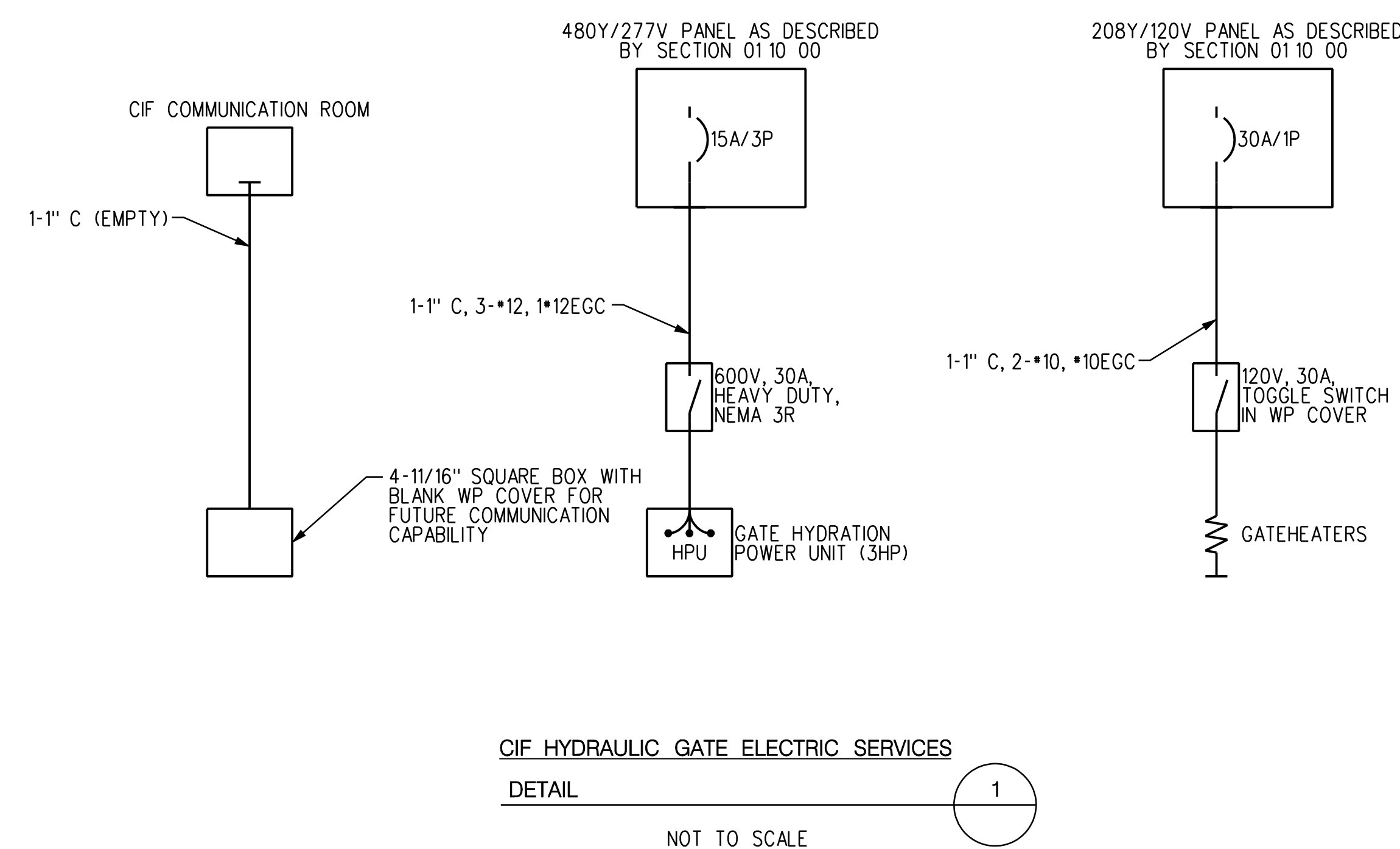
1. ALL COMMUNICATION WORK SHALL BE IN ACCORDANCE WITH TECHNICAL CRITERIA FOR INSTALLATION INFORMATION INFRASTRUCTURE ARCHITECTURE (ISA), FEBRUARY 2010.
2. COORDINATE WORK WITH FORT SILL NEC THROUGH CONTRACTING OFFICER. WORK PERFORMED BY FORT SILL DOM IS NOT IN CONTRACT.
3. PROVIDE ALL NEW COMMUNICATION MANHOLES, COMMUNICATION DUCTBANK, INNERDUCTS, AND PULS STRINGS. COMMUNICATION MANHOLE AND DUCTBANK DETAILS SHOWN ON E500.
4. PROVIDE 4-WAY 4" COMMUNICATION DUCTBANK BETWEEN EACH MANHOLE.
5. PROVIDE 4-WAY 4" COMMUNICATION DUCTBANK BETWEEN MANHOLE MH-T2-4A AND CIF COMMUNICATION ROOM.
6. PROVIDE 2-WAY 4" COMMUNICATION DUCTBANK STUBBED OUT TO APPROXIMATELY 10' EAST OF MANHOLE MH-T2-4A.
7. PROVIDE 4-WAY 4" COMMUNICATION DUCTBANK STUBBED OUT TO APPROXIMATELY 10' SOUTH OF MH-T2-4B.
8. FORT SILL NEC SHALL PROVIDE ALL OSP CABLING, SPLICES, TERMINATIONS AND TERMINATION HARDWARE.
9. NEW OR RELOCATED CABLES ARE SHOWN IN BOLD AND IDENTIFIED AS "NEW." EXISTING CABLES ARE SHOWN LIGHTLY SHADED.

MANHOLE BUTTERFLY LEGEND

- CABLE TO BE DEMOLISHED
- EXISTING CABLE
- NEW CABLE
- - - - RELOCATED CABLE
- CMH COMMUNICATION MANHOLE
- P2700-26PF INDICATES COPPER CABLE, 2700-PAIR TELEPHONE CABLE, 26 AWG, PLASTIC INSULATED CONDUCTORS, FILLED.
- FOC FIBER OPTIC CABLE
- SM SINGLE MODE
- N2F04 NODE TWO FIBER OPTIC CABLE \*4
- N2C12 NODE TWO TELEPHONE PAIR CABLE \*12
- MH-N2-2 MANHOLE SERVING NODE 2, \*2
- ID INNERDUCTS
- DCO DIAL CENTRAL OFFICE
- XD CROSS CONNECTED
- CC CLEAR CAPPED OR CENTER TO CENTER
- ⊕ VACANT DUCT
- ⊕ INDICATES 4-WAY INNERDUCT WITHIN ONE DUCT
- ⊕ INDICATES FIFTY FOOT COIL OF CABLE, BEND RADIUS OF CABLE SHALL BE MINIMUM OF TWELVE TIMES CABLE OD OR PER MANUFACTURES INSTRUCTION.
- ⊕ INDICATES DIRECTION TOWARDS SOURCE OF COMMUNICATION CABLES "DCO" INDICATES DIGITAL CENTRAL OFFICE.



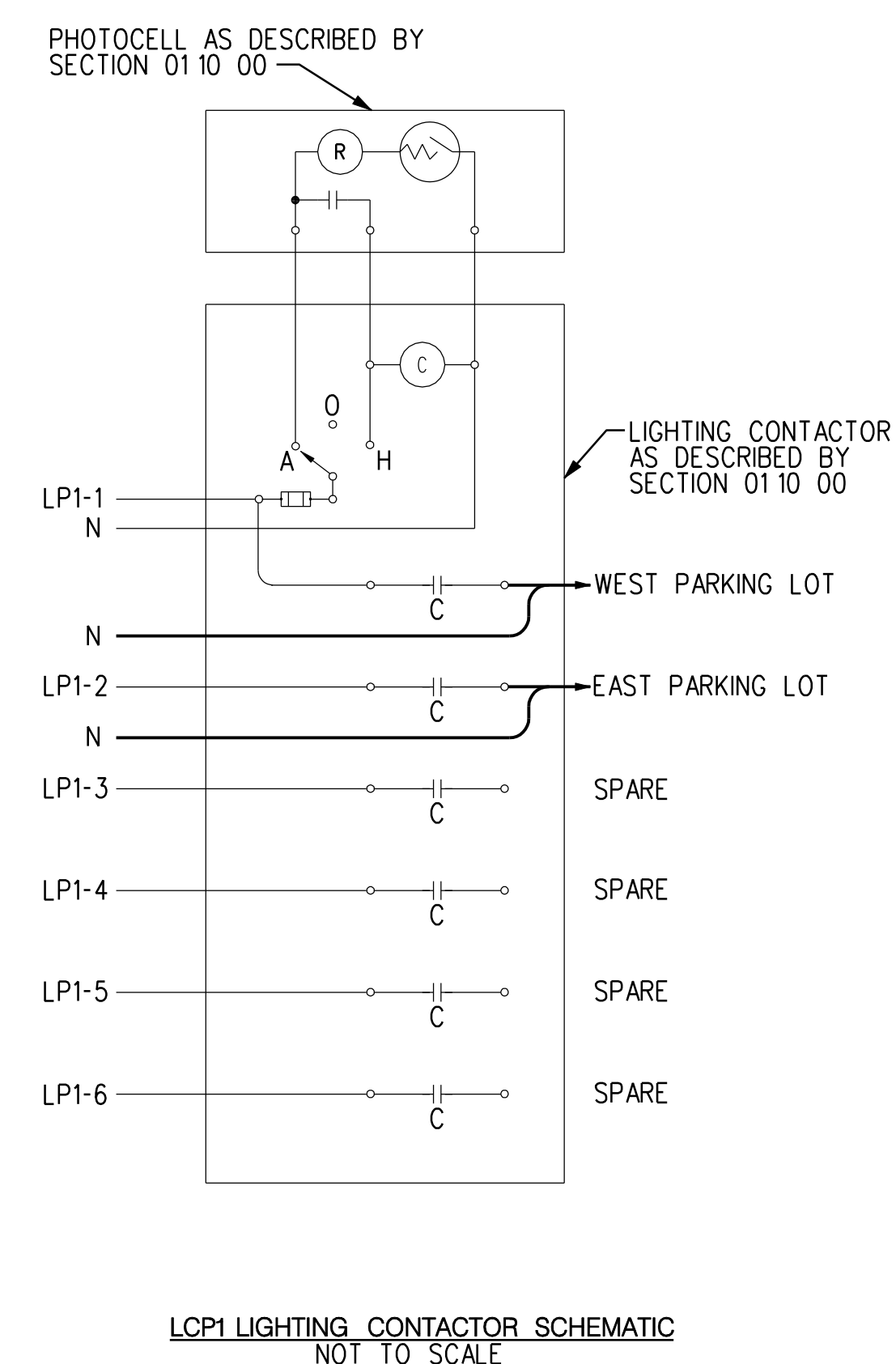
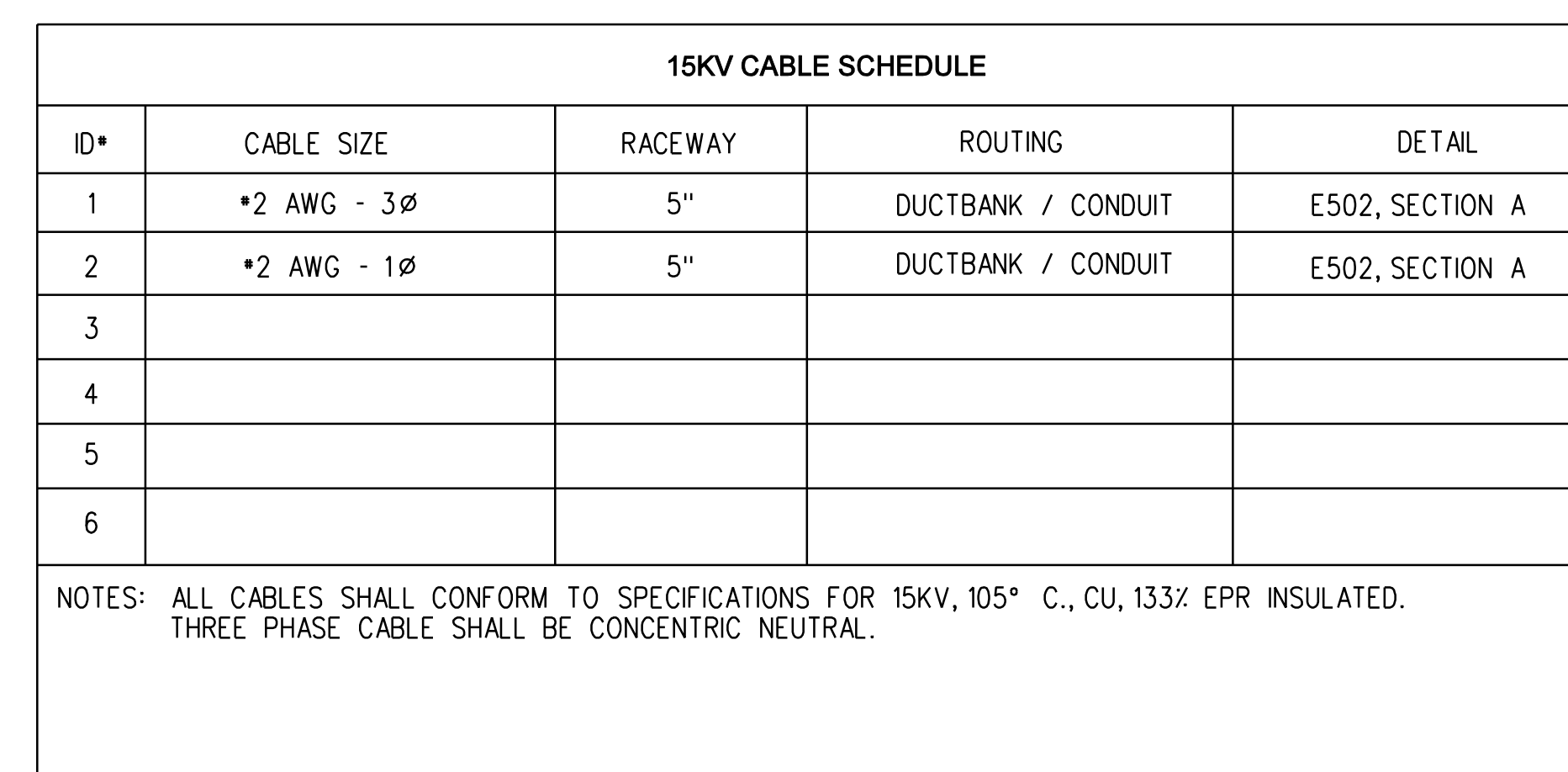
| SYMBOL  | DESCRIPTION         | DATE   | APPR                         |
|---|---------------------|--|------------------------------|
|  51121 |                     |  |                              |
|        |                     |  |                              |
| DESIGNED BY:<br>B. POOLE  |                     | FORT SILL ARMY POST<br>OKLAHOMA                            |                              |
| DRAWN BY:<br>P. DAMICO  |                     | PDC: 65299 FY: 10  |                              |
| REVIEWED BY:<br>T. PARADEIS   |                     | CENTRAL ISSUE FACILITY<br>(CIF)                            |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC.  |                     | COMMUNICATIONS ONE-LINE DIAGRAM<br>AND MANHOLE BUTTERFLIES |                              |
| PLOT SCALE:<br>AS SHOWN   | DWG. CODE:          | CONTRACT DATE:   | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br>FS09CFE-600.DGN   | RFP NO.<br>W912BV-- | E600   |                              |
| PLOT DATE:<br>XX-XXX-2009   | SHEET<br>38 OF 41   | CONTRACT NO.<br>W912BV--                                   |                              |



**KEYED NOTES:**

① PROVIDE 600V, 600A, 3 POLE, 25 KAIC THERMAL MAGNETIC CIRCUIT BREAKER WITHIN NEMA 3R ENCLOSURE WITH EXTERNAL DISCONNECT.

② SEE PANELBOARD SCHEDULE THIS SHEET.

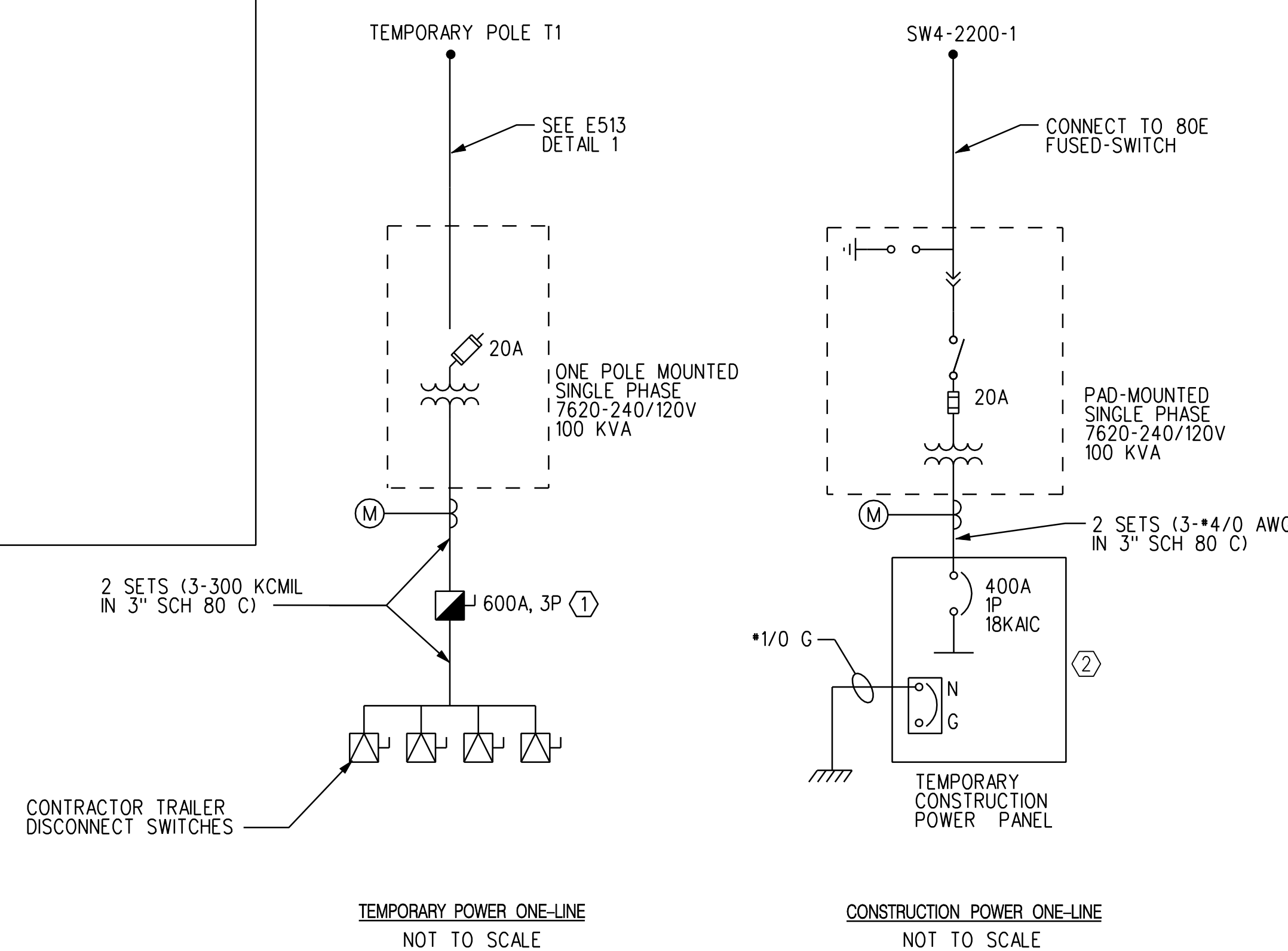




|                  |  |                                    |  |                                    |  |                           |  |
|------------------|--|------------------------------------|--|------------------------------------|--|---------------------------|--|
| PANELBOARD NAME: |  | TEMPORARY CONSTRUCTION POWER PANEL |  | 18,000 RMS SYMMETRICAL A I.C.      |  |                           |  |
| PANELBOARD TYPE: |  | MAIN CIRCUIT BREAKER               |  | SURFACE MOUNTED, NEMA 3R ENCLOSURE |  | 400 AMP TRIP MAIN BREAKER |  |
| PANEL LOCATION:  |  | PAD-MOUNTED SWITCH, C/F TEMPORARY  |  | 120/240 VOLTS, 1 PHASE, 3 WIRE     |  | 400 AMP MAINS             |  |
| SUPPLIED FROM:   |  | TEMPORARY TRANSFORMERS             |  |                                    |  |                           |  |

| OKT NO | TRIP AMPS | NO. POLES | WIRE / CONDUIT | GND WIRE | LOAD SERVED | LOAD VA | Ø | LOAD VA | LOAD SERVED      | GND. WIRE | WIRE / CONDUIT | NO. POLES | TRIP AMPS | OKT NO |
|--------|-----------|-----------|----------------|----------|-------------|---------|---|---------|------------------|-----------|----------------|-----------|-----------|--------|
| 1      | 100       | 2         |                |          | SPARE       | 7000    | A | 7000    | SPARE            |           |                |           | 2         | 1      |
| 5      | 100       | 2         |                |          | SPARE       | 7000    | A | 7000    | SPARE            |           |                | 2         | 50        | 6      |
| 9      | 100       | 2         |                |          | SPARE       | 7000    | A | 360     | GFCI QUAD RECEPT | #12       | 2-#12, 3/4"    | 1         | 20        | 10     |
| 13     | 50        | 2         |                |          | SPARE       | 3500    | A | 360     | GFCI QUAD RECEPT | #12       | 2-#12, 3/4"    | 1         | 20        | 12     |
| 17     | 50        | 2         |                |          | SPARE       | 3500    | B |         | SPACE            |           |                |           |           |        |
|        |           |           |                |          | SPARE       | 3500    | A |         | SPACE            |           |                |           |           |        |
|        |           |           |                |          | SPARE       | 3500    | B |         | SPACE            |           |                |           |           |        |
| 21     | 50        | 2         |                |          | SPARE       | 3500    | A |         | SPACE            |           |                |           |           |        |
|        |           |           |                |          | SPARE       | 3500    | B |         | SPACE            |           |                |           |           |        |

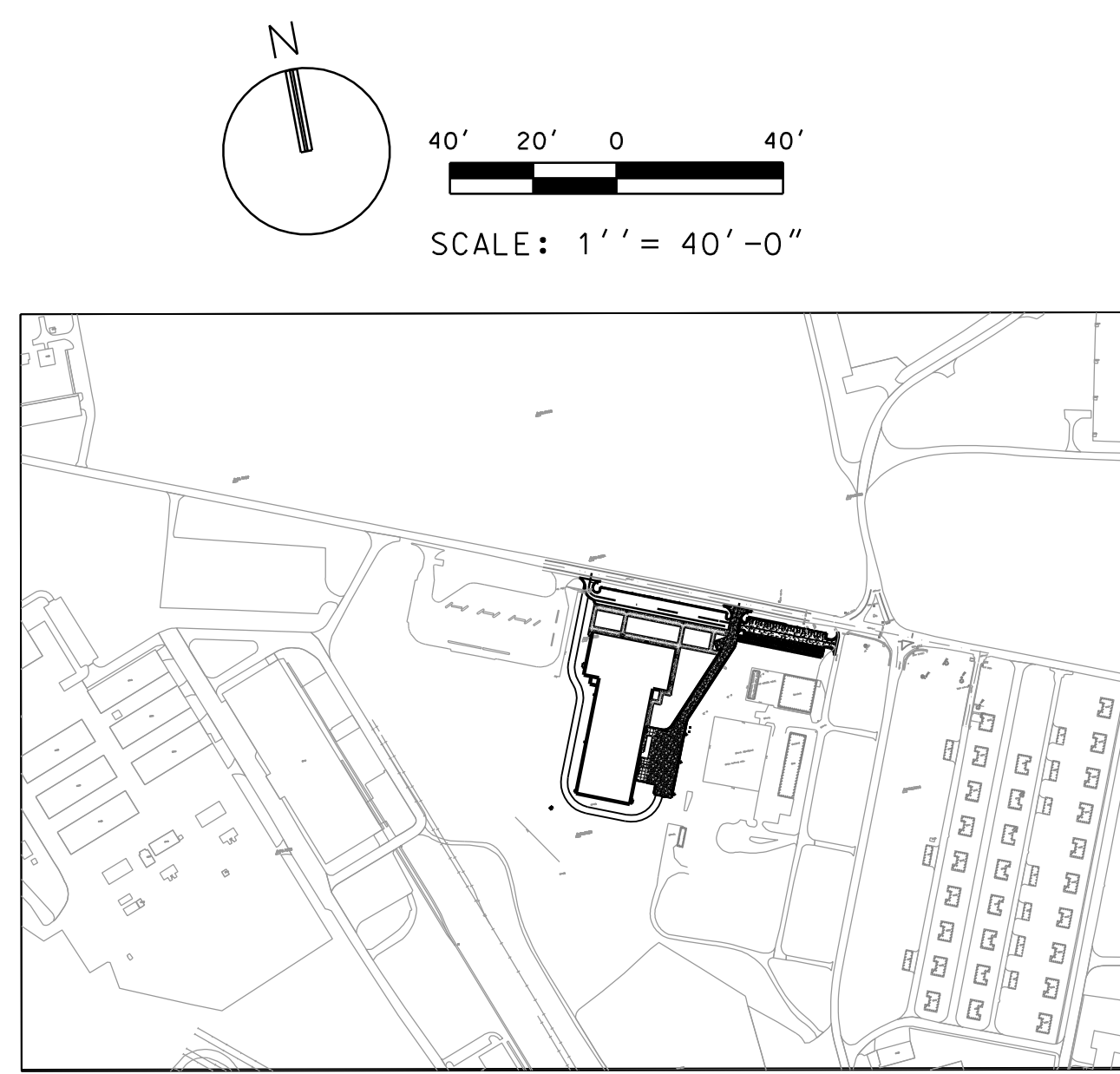
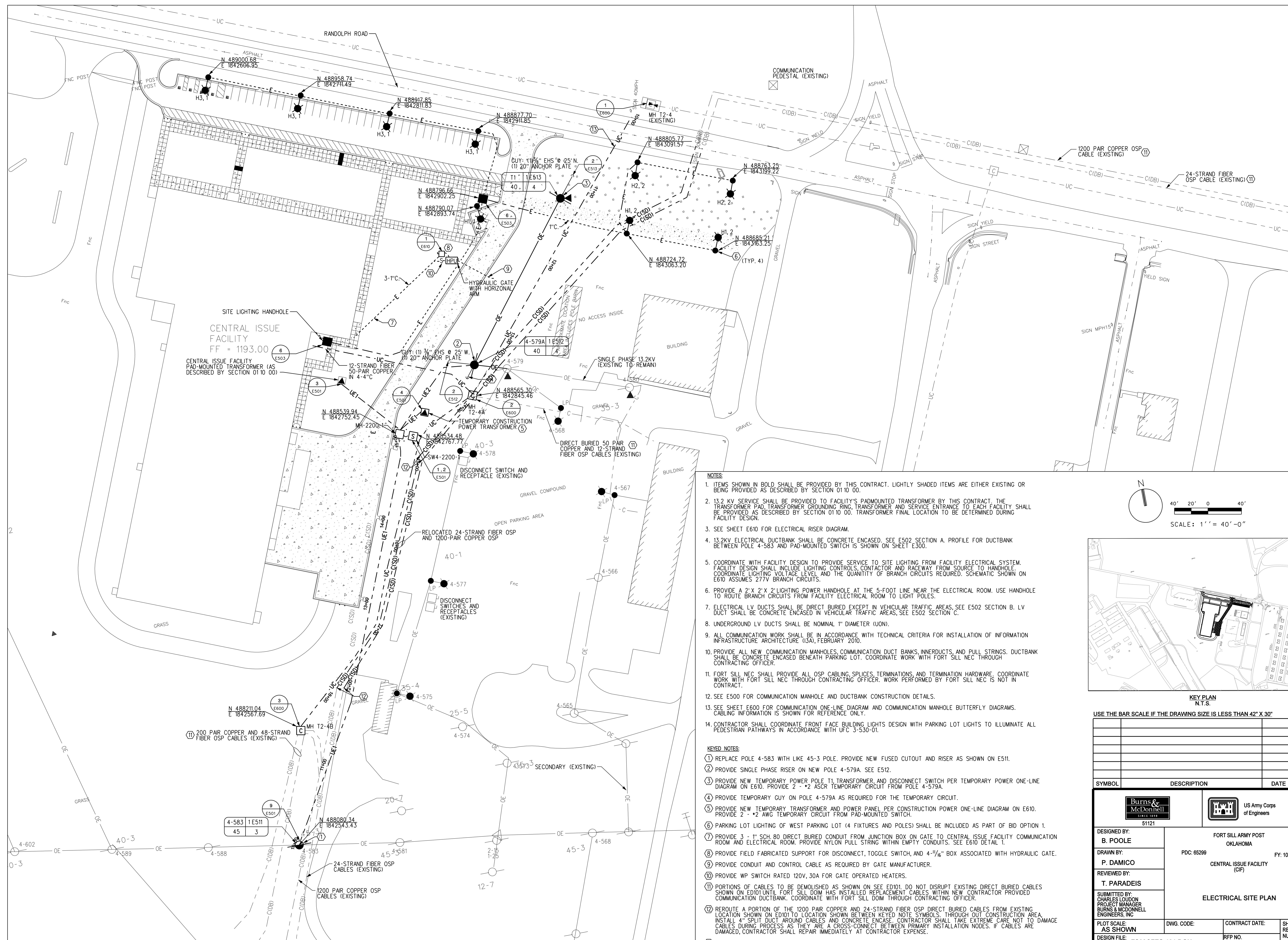
TOTAL CONNECTED LOAD = 84.7 kVA X .50% DEMAND FACTOR = 42.7 kVA ESTIMATED DEMAND LOAD  
 PHASE BALANCE (KVA) : A: 42.4, B: 42.4



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|   |  |                        |  |                              |             |
|   |  |                        |  |                              |             |
| S | YMBOL  | D                      | DESCRIPTION                              | E                            | DATE APPR   |
|   | <div style="display: flex; justify-content: space-between;"> <div style="width: 40%;">  <p>51121</p> </div> <div style="width: 40%; text-align: center;">  <p>US Army Corps<br/>of Engineers</p> </div> </div> |                        |  |                              |             |
|   | DESIGNED BY:<br><b>B. POOLE</b>  |                        | FORT SILL ARMY POST<br>OKLAHOMA          |                              |             |
|   | DRAWN BY:<br><b>P. DAMICO</b>  |                        | PDC: 65299                               | FY: 10                       |             |
|   | REVIEWED BY:<br><b>T. PARADEIS</b>   |                        | CENTRAL ISSUE FACILITY<br>(CIF)          |                              |             |
|   | SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & MCDONNELL<br>ENGINEERS, INC  |                        | ELECTRICAL RISER DIAGRAMS<br>AND DETAILS |                              |             |
|   | PILOT SCALE:<br><b>AS SHOWN</b>  | DWG. CODE:             | CONTRACT DATE:                           | SHEET<br>REFERENCE<br>NUMBER |             |
|   | DESIGN FILE: <b>FS09CFE-610.DGN</b>  |                        | RFP NO.<br>W812BV--                      |                              |             |
|   | PILOT DATE:<br>XX - YY - 2000  | SHEET    39   OF    41 | CONTRACT NO.                             |                              | <b>E610</b> |







| USE THE BAR SCALE IF THE DRAWING SIZE IS LESS THAN 42" X 30"                               |  |                          |                              |
|--|--|--------------------------|------------------------------|
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|  |  |                          |                              |
|  |  |                          |                              |
|  |  |                          |                              |
| SYMBOL   | DESCRIPTION  | DATE                     | APPR                         |
|  | 51121  |                          |                              |
| DESIGNED BY:<br><b>B. POOLE</b>  | <b>FORT SILL ARMY POST</b><br><b>OKLAHOMA</b><br><b>PDC: 65299</b><br><b>CENTRAL ISSUE FACILITY</b><br><b>(CIF)</b><br><b>ELECTRICAL SITE PLAN</b> |                          |                              |
| DRAWN BY:<br><b>P. DAMICO</b>  |  |                          |                              |
| REVIEWED BY:<br><b>T. PARADEIS</b>   |  |                          |                              |
| SUBMITTED BY:<br>CHARLES LOUDON<br>PROJECT MANAGER<br>BURNS & McDONNELL<br>ENGINEERS, INC. |  |                          |                              |
| PLOT SCALE:<br><b>AS SHOWN</b>   | DWG. CODE:   | CONTRACT DATE:           | SHEET<br>REFERENCE<br>NUMBER |
| DESIGN FILE:<br><b>FS09CFES-101.DGN</b>  |  | RFP NO.<br>W9126V--      | <b>ES101</b>                 |
| PLOT DATE:<br>XX-XXX-2009  | SHEET<br>41 OF 41  | CONTRACT NO.<br>W9126V-- |                              |

## **Appendix FF**

### **Infrastructure Specifications**

# ***95% Design Submittal Primary Infrastructure Specifications***



## **Central Issue Facility (CIF) Fort Sill, Oklahoma**



*Prepared for*  
**US Army Corps of Engineers  
Tulsa District**



**August 2010  
Project Number 51121**

Friday, February 18, 2011





Central Issue Facility  
Primary Infrastructure

Ft. Sill, OK

## PROJECT TABLE OF CONTENTS

### DIVISION 01 - GENERAL REQUIREMENTS

|                |   |
|----------------|---|
| 01 04 00       | COORDINATION, FIELD ENGINEERING, AND MEETINGS     |
| 01 10 00       | SAFETY  |
| 01 27 00       | MEASUREMENT AND PAYMENT                           |
| 01 32 01.00 10 | PROJECT SCHEDULE                                  |
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SECTION 01 04 00

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

Title 29 CFR 29, Part 1926 Construction Safety and Health Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-09 Manufacturer's Field Reports

Survey Field Notes; G

Promptly upon completing a survey in accordance with paragraph: QUANTITY SURVEYS, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

1.3 WORK SCHEDULE

Contractor shall work between 8 a.m. and 5 p.m. Monday through Friday unless otherwise directed by the Contracting Officer.

1.3.1 Construction Sequence Notes

a. Site Analysis

The project consists of the site planning a central issue facility (CIF) to support relocation of the 31st BDE air defense artillery (ADA) from fort bliss, Texas to Fort Sill as part of the Base Realignment and Closure Act 2005.

The design work in this project consists of constructing new primary infrastructure utility systems to support the new facility utility requirements, construct new POV parking lots, roads and sidewalks. The work includes the construction of new water distribution mains, sewer mains, gas distribution mains, and electrical/communication ductbanks. There will be demolition and relocation of portions of the existing utility systems to clear the sites for new facility construction.

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The facility is being designed and constructed utilizing design/build contracts through the Tulsa district corps of engineers with support from several other district offices and the use of IDIQ contracts for some of the standard facility types.

b. Grading

A rough grading plan is being developed for the entire site and will be included in the Design/Build RFP Documents. The portion of the project site that is covered under this design will have final grading of the parking lots, roads, etc. That will match into the Rough/Proposed Grading Plans for the CIF D/B Contractor. The grading will have a minimum slope of 1 percent for concrete pavements, 2 percent for asphalt pavements, minimum 1 percent for sidewalks with a maximum of 5 percent, and a minimum 5 percent for the first 10 feet around facilities. All sidewalks will be designed with handicap accessible ramps at street intersections with curb and gutter.

c. Storm Drainage

Each contractor will be responsible for maintaining their own site in accordance with the Oklahoma department of environmental quality stormwater pollution prevention measures.

The infrastructure contractor will be responsible for maintaining the site in accordance with the Oklahoma Department of Environmental Quality Stormwater Pollution Prevention Measures until building pad acceptance at which time the CIF D/B Contractor will be responsible for maintaining erosion and sediment control of the building pad and out to the approximate 5 foot line. A draft SWPPP plan is being completed as part of the design package for use by the Contractor in developing and submitting the documents to ODEQ.

A new stormwater detention pond may be designed and constructed to control the post development runoff so as not to exceed the pre-development runoff near the central issue facility area. The pond will consist of an earth berm with a drainage culvert at the bottom to drain the ponds at the designed flow rate over the course of a couple days depending on the size of the rainfall event. The pond will be designed as a dry pond that will drain empty after each rainfall event and will not retain water for long periods of time. The location and size of the pond is being developed as the design continues.

The new construction will require the regrading and rerouting of several small drainage swales around the new facilities as well as construction of new culverts under sidewalks and parking lots.

The proposed storm drainage improvements will be designed using the rational method and be in accordance with all UFC standards for pipe sizing, slopes, and materials.

The new storm drainage piping will consist of corrugated exterior HDPE pipe with smooth wall interior or reinforced concrete pipe. The HDPE pipe material requires less heavy equipment and personnel to install in comparison to the RCP pipe and is used for civilian

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and commercial construction on a regular basis.

d. Water Supply and Distribution

As part of the project, the existing fire hydrants in the area are to be tested and the data provided to awe to check against their model. After discussion with awe it has been determined there are no connection points or fire hydrants on the 12" available for flow testing. At this time it has been agreed the system will be able to provide sufficient water pressure and flows to meet the anticipated demands of the facility without requiring pumps or upgrades to the mains. This will be verified once the re-route of the 12" line and new fire hydrants have been installed as part of this project. New lateral service lines will be installed from the existing mains to the new building. This information will be verified with awe and updated accordingly.

All of the fire hydrant flow data, estimated domestic water demands, fire water demands for the new facility, and water modeling from a previous project not constructed in the area are included in Appendix G.

e. Sanitary Sewer

The estimated sewer flows for each of the proposed buildings will be sent to awe to analyze against their model to determine if the downstream system has the capacity to handle the additional flow. It is anticipated the additional flows from the new facilities does not exceed the capacity of the system.

The new mains will vary in size from 6 inches to 8 inches. The new mains and service lines will have pre-cast manholes installed to allow for the connection of the new facility. All sewer distribution design and construction will be in accordance with American Water Enterprise (AWE) Standards as they are the owner and permit holder with ODEQ for the system. Awe will review the proposed design at each submittal and provide review comments.

The sanitary sewer will consist of PVC SDR 35 pipe unless crossing streets where it will be SDR 21. Precast manholes will be utilized with HS20 loaded frame and covers in accordance with ASTM C478.

f. Gas Supply and Distribution

Any new gas distribution piping will be installed at no cost by ONG but all relocation costs must be reimbursed. ONG will review the design documents to make sure the layout indicated is in line with their requirements and the function of the entire system for Ft. Sill.

g. Landscaping

There are no known irrigation systems in the area of the new project work and there is no requirement for new irrigation around the parking lots or road improvements. There will be some exterior hose bibs on the facilities to allow for watering of low growth plantings adjacent to the building.

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Existing landscaped areas will be maintained to the maximum extent possible but some trees, shrubs, etc. will be removed to allow for the grading and drainage improvements to the area.

Replacement trees, shrubs, turf and vegetation will be selected based on native species, which are drought resistant and match the theme for the area. The extent of new landscaping will depend on project funding.

#### h. Electrical System

13.2 KV service shall be provided to the central issue facility's pad mounted transformer. The transformer and 480 volt secondary service entrance to each facility shall be part of the central issue facility's contract.

7.62 KV single phase service shall be provided to existing transformer on poles 4.579 and 4.580.

The distribution system to the central issue facility shall be underground and fed from a new fused cutout on pole 4-583.

#### i. Communication System

Ductbank shall be constructed from existing manholes and building to within 5.00' of the central issue facility. Facility's contract shall extend these ductbank to facility communication room.

Existing fiber optic and telephone cables within the system have the spare capacity to provide all service required by this project. Fort Sill DOIM shall provide and terminate outside plant (OSP) cable from the existing communication system connection to the central issue facility.

### 1.4 UTILITY OUTAGES

All utility outage request dates and times will be set by the appropriate Government agency. Each individual outage request (according to type of outage) will be set for either normal working hours or after hours/weekends. Outages shall be coordinated on a case-by-case basis through the Contracting Officer. Utility outages frequently affect more than one facility and require extensive coordination. The Contractor shall perform all tests, have passed all inspections required in the specifications and/or on the project drawings and coordinate between the Contracting Officer's representative and Government shops prior to requesting the outage. The Contractor shall have on site all tools, equipment and materials required prior to the start of the utility outage. The Contractor shall submit all requests for outages in accordance with paragraph entitled UTILITY OUTAGE COORDINATION.

### 1.5 UTILITY OUTAGE COORDINATION

#### 1.5.1 Approval

The Contractor shall obtain written permission/approval from the Contracting Officer 21 days prior to:

- (1) Performing any work which will close any runway or street or

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interrupt any utility service.

(2) Making any excavation: Any damage to underground utilities, communication lines, etc., will be the responsibility of the Contractor if the approval is not obtained.

(3) Contractors shall use extreme care in all excavations on Tinker AFB. Subsurface utilities are congested in nature. Damaging these systems in some areas could result in thousands of man-hours of lost production time, which could result in claims against the Contractor to the extent of the actual supportable damage.

(4) Utility outages: The proposed outage request shall indicate the proposed work and length of outage.

(5) The Contractor shall consult with Department of Public Works shop personnel on utility isolation points; once authority has been granted, the Contractor shall perform the utility isolation without Government shop personnel present. The Contractor shall be responsible for restoring the utility and re-setting any special equipment affected by the outage, assuming that the equipment is located in the area turned over to the Contractor as part of the construction contract. Only Government exterior electric personnel can isolate any primary electric source or restore primary electric power, unless express authorization has been granted by Government exterior electric.

#### 1.5.2 Government Right to Delay

The Government reserves the right to postpone for 7 days, any scheduled outages. There shall be no outages when the outside temperature is expected to be below 35 degrees F.

#### 1.5.3 Government Performance

Government personnel shall perform all shutting off and turning on of valves and switches necessary to accomplish scheduled outage.

#### 1.6 TEMPORARY POWER

The Contractor shall assess power requirements for construction and shall make a request to the Contracting Officer regarding location of transformer and location of tap into existing primary power grid. Under no circumstances shall the Contractor install temporary power prior to receiving written approval from the Contracting Officer. Contractor is solely responsible at his/her expense for supplying and installing required transformers and making the primary connection once his/her electrical plan is approved. Only Government exterior electric personnel can isolate the primary line so the Contractor can connect to the primary power grid. The Contractor shall request the electrical outage as required in paragraphs above. An outage shall be made only if the Contractor is ready to install his fused cutouts or other isolating/switching media and the duration of the outage shall be minimized to the fullest extent. An electrical consumption meter shall be installed in line on the secondary side of the temporary connection for the purposes of recording consumption. See Section 01 50 00 for additional requirements.

#### 1.7 EXCAVATION

Contractor shall be aware that subsurface utilities are very congested.



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Use extreme care in making excavations. Damage to utilities will be handled in accordance with paragraph entitled UTILITY OUTAGE COORDINATION.

#### 1.7.1 Protection of Existing Utilities

Prior to any excavation, the Contractor shall mark with permanent paint or dye all locations of proposed excavation(s) (including all building lines and proposed utility routes) and inform the Contracting Officer in writing that the areas have been marked. The Contractor shall go to Department of Public Works and request an Excavation Permit Request form. The Contractor is responsible for the following key items:

- a. Having the excavation site clearly marked in the field;
- b. Attaching a combined utility map, clearly highlighted, to show the limits of excavation;
- c. Obtaining a control number from CALL-OKIE (for all commercial utilities).

The Contractor shall inform the Contracting Officer when the areas is ready for inspection. Once the Storm Water Pollution Prevention Plan (see Section 01 56 01) has been approved by Environmental Management, the line-marking process will begin. The Contractor shall be responsible for informing the Safety Office, as directed by the Contracting Officer, before commencing open trench excavation to a depth of 4 feet or more. The Contractor shall be responsible for renewing the Excavation Permit Request every 30 days for as long as there is excavating in progress for a given location. The Contractor shall be responsible to maintain/protect the lines once marked, but if the original marked lines are no longer visible to the Contractor, the Contracting Officer's representative shall be notified to coordinate the proper Government Agency to re-mark the lines, on a case-by-case basis. The Contractor shall begin excavation upon receipt of the Excavation Permit Request. The Excavation Permit Request shall be maintained at the construction site and made available for inspection by the Government.

##### 1.7.1.1 Excavation Methods

Excavation may be accomplished by hand or by use of a mechanical digger. Use of a continuous trencher or plow is prohibited unless permission is obtained, in writing, from the Contracting Officer prior to bringing equipment on Post.

##### 1.7.1.2 Existing Utility Locations

The Contractor shall be responsible for determining the precise location and depth of existing utility lines by hand excavating from a point 6 feet on either side of the previously staked utility location, until the line is completely exposed. After all lines are so located and completely exposed to the satisfaction of the Contracting Officer's representative, machine excavation may begin. Machine excavation shall not be used immediately adjacent to a known unexposed utility.

##### 1.7.1.3 Excavation Safety Measures

All excavations, trenches, open manholes, etc. shall be properly shored, braced, barricaded or guarded in accordance with the provisions of Title 29 CFR 29, Part 1926. Warning lights or other illumination maintained from sunset to sunup, shall be placed at all excavations which are adjacent to pedestrian or vehicle thoroughfares. Adequate physical

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protection shall be provided at all remotely located excavations.

#### 1.8 LAYOUT OF WORK (APR 1984) (FAR 52.236-17)

The Contractor shall lay out his work from Government-established base lines and bench marks indicated on the drawings and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, and materials and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through his negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

#### 1.9 MONUMENT REPLACEMENT

##### 1.9.1 General

Government-established horizontal and vertical control monuments that are shown on the drawings, if destroyed shall be reestablished by the Contractor in locations as directed by the Contracting Officer. Control points set by the Contractor for the purpose of reestablishing the monuments and to properly control the work, if destroyed and not reset by the Contractor, shall be reestablished by the Government at the Contractor's expense. Survey shall be performed by a Registered Land Surveyor.

##### 1.9.2 Horizontal Control

Horizontal control shall be based on the State Plane Coordinate System as developed by the National Geodetic Survey. Horizontal control shall originate and close on control points established by the Government.

##### 1.9.3 Vertical Control

Elevations shall originate and close on vertical controls established by the Government. Third Order Accuracy or better shall be maintained for all vertical survey control. Vertical error shall be adjusted for all control markers established throughout each level loop. A transcript of all adjusted vertical marks set and adjusted horizontal marks set, shall be furnished on forms furnished by the Government. (SWD Form 598)

##### 1.9.4 Monuments

Concrete monuments shall be set as control monuments, where required. Horizontal data for monuments is based on NAD 27, and vertical data is based on NGVD 29 in US feet. The monuments shall consist of 6-inch -diameter concrete posts of standard mix and a Government-furnished bronze disk flush with top, set at least 2.6 feet into solid ground and 0.4 foot above the ground surface. A No. 4 18-inch reinforcing bar shall be cast in the top portion of the monument. Each monument shall be identified by stamping the bronze disk with steel dies, indicating thereon the name of the site and number of the monument. A Government-furnished galvanized U-channel rail steel delineator post, 6.5 feet in length with a USCE sign attached shall be set in concrete within 1 foot of each control monument.

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Markers which fall in roads or improved areas shall be either buried or a disk set flush in pavement, whichever may be appropriate to the situation. Control monuments shall be referenced by chain distance and angle to at least three objects, such as blazed trees, crosses in solid rock, or other physical features in the immediate vicinity.

#### 1.10 OTHER CONTRACTORS

(Reference CONTRACT CLAUSE entitled "Other Contracts.") Other Contractors may be working in the project area during construction under this contract. The Contractor shall arrange and perform his work and store his materials in cooperation with other Contractors and as directed by the Contracting Officer.

#### 1.11 TRAFFIC

All Contractor personnel shall observe Post traffic regulations. Information regarding such regulations shall be requested from the Contracting.

##### 1.11.1 Truck Traffic Entering Ft. Sill, Oklahoma

All truck traffic shall enter Ft. Sill through Ft. Sill Blvd. gate as indicated on the drawing. The hours of operation for commercial truck inbound traffic gate will be 24 hours per day, 7 days per week. The truck gate entry procedures entail normal entry requirements as well as driver ID and verification of bill of lading/manifest. After verification, trucks are directed to the search area. Once the trucks have been searched, they will be allowed to proceed to their destination. Prioritization of entry procedures will allow certain vehicles, containing time-sensitive cargo (i.e, cement trucks, blood mobile, etc.) the ability to prioritize their place in queue and facilitate entry onto the installation. Prioritization may be facilitated by use by telephoning ahead to 405-734-2008.

Escort procedures apply only to personnel assigned to Ft. Sill, to include all permanent and temporary contractors in possession of a valid Ft. Sill-issued contractor's badge, may act as a sponsor and provide escort to trucks entering the installation. When Entry Authority List (EAL) is required, sponsors must hand carry the EAL to the Security Forces Operations Section for authentication (faxes, telephone calls, and emails are not permitted).

##### 1.11.2 Gates and Haul Route

The Contractor shall use the gate indicated above or as directed by the Contracting Officer. Unless otherwise shown or directed by the Contracting Officer, the haul route shall be the most direct route from the gate to the construction site. Haul route(s) shall be approved by the Contracting Officer. Reference Section 01 50 00 for additional haul route requirements.

##### 1.11.3 Street Closure

The Contractor shall maintain at least one lane (at least two lanes on four lane roads) of traffic at all times on all streets, roads, and driveways unless directed by the Contracting Officer.

##### 1.11.4 Utility Street Crossings

All street crossings shall be done by directional boring of new utility

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lines.

#### 1.12 POST SECURITY

Ft. Sill is an active Department of Defense facility and access to certain areas on Ft. Sill are strictly controlled.

The Contractor will be briefed by the Contracting Officer on Post security requirements. The Contractor shall be responsible for ensuring all employees (including employees of subcontractors) adhere to Base security regulations. Refer to Section 01 50 00 for additional requirements.

The Contractor shall provide all required barricades and warning devices to protect the work area. In the event that unauthorized personnel trespass on the construction site, the Contracting Officer shall be notified immediately.

The Contractor shall ensure all privately-owned vehicles operated by Contractor or subcontractor personnel are properly registered with Post Security. Registration information shall be obtained from the Contracting Officer.

Contractor and subcontractor personnel shall limit their travel on Post to roads leading directly to the construction site parking, storage areas, and haul routes.

#### 1.13 MATERIAL AND EQUIPMENT DELIVERIES

The Contractor shall furnish information to the supplier as to assignee, contract number, project number, project title, and location (building or other) where material and equipment are to be shipped direct. Material shipped directly to Ft. Sill will not be accepted by Post personnel. Any loss related thereto shall be the responsibility of the Contractor. Contractor shall be responsible to accept, unload and store shipped material. The supplier shall have all necessary information required by Base Security upon entry to Ft. Sill.

#### 1.14 WORK SITE REVIEW

Prior to starting any work, the Contractor shall inspect the work area(s) to determine the physical condition of the area. The Contractor, as a result of this inspection, shall promptly notify the Contracting Officer, in writing, of any existing damage(s) or condition(s) that could interfere with work on this contract.

#### 1.15 STANDARD PRODUCTS/SERVICE AVAILABILITY

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design, and workmanship. The standard products shall have been in satisfactory commercial and/or industrial use for 2 years prior to date of solicitation and still is in production. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. No obsolete, or out of production, materials shall be installed. The 2-years experience shall be satisfactorily completed by a product, which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than 2 years field service record may be acceptable, if a certified record of satisfactory field

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operation, for not less than 6000 hours exclusive of the manufacturer's  
factory or laboratory tests, can be shown and approved in writing by the  
Contracting Officer.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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SECTION 01 10 00

SAFETY

PART 1 GENERAL

1.1 REFERENCES

OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA)

OSHA 1926.21(b)(6)

OSHA Standards for the Construction  
Industry

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1

(2006) Safety -- Safety and Health  
Requirements

1.2 Submittals

Government approval is required for all submittals. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Contractor Health and Safety Plan

Submit detailed plan of Contractor's actions to safeguard Contractor and government personnel and equipment.

The Contractor shall submit four (4) copies of the Health and Safety Plan, detailing procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done. The Safety Plan shall emphasize the protection of occupants residing near the work site of construction operations.

SD-07 Certificates

Report of Accident and Exposure Data

The Contractor shall submit a Report of Accident and Exposure Data on SWD Form 743-R not later than the 5th day of each month.

Monthly Hazardous Material Usage Report

The Contractor shall submit the Monthly Hazardous Usage Report, form located at the end of this section, not later than the 4th work day of each month for information on the preceding month. If no hazardous materials were used, annotate "NONE" on the report.

Certification of Completion

The Contractor shall be responsible for testing and re-certification of all fire alarm systems that are modified by addition, deletion, or relocation of devices during construction.

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1.3 SAFETY AND HEALTH REQUIREMENTS MANUAL (EM 385-1-1, Nov 03).

In accordance with CONTRACT CLAUSE Paragraph "ACCIDENT PREVENTION", EM 385-1-1 applies to all work under this contract. There are submittals and testing required by this manual which require Government Approval (G) before certain phases of work can begin.

1.4 MANAGEMENT OF CONTRACTOR-GENERATED HAZARDOUS WASTES AND PETROLEUM PRODUCTS (40 CFR, PART 262)

Contractors generating hazardous wastes and petroleum products on the military base on which this contract is performed shall be responsible for their management responsibilities as described in 40 CFR, Part 262 and with the Oklahoma State Industrial Waste Management Regulations.

1.5 MONTHLY EXPOSURE REPORT

A monthly report of accident and exposure data shall be submitted by the Contractor in accordance with paragraph entitled SUBMITTALS. The report shall be submitted on SWD Form 743-R "MONTHLY EXPOSURE REPORT OF OPERATIONS AND ACTIVITIES" which will be provided to the Contractor at the pre-construction conference.

1.6 MONTHLY HAZARDOUS MATERIAL USAGE REPORT

The Contractor shall submit the Monthly Hazardous Material Usage Report in accordance with the requirements of the paragraph entitled SUBMITTALS.

1.7 ACCIDENT PREVENTION PREPLANNING (SWTCD)

In addition to the requirements of the CONTRACT CLAUSE entitled "Accident Prevention," the Contractor shall:

a. Meet with the Contracting Officer and/or his representative before each major phase of construction. The purpose of the meeting will be to identify the specific hazards that are associated with that phase of construction. The meeting will include the general Contractor's superintendent, Quality Control Inspector, and superintendent or foreman in charge of the operation whether performed by the general Contractor or subcontractor.

b. Identify at this meeting what construction methods and equipment will be used to protect the workmen against the hazards that are anticipated during that phase of construction. This plan, when agreed upon by the Contracting Officer and Contractor, will become a part of the Contractor's safety program.

c. Be responsible for insuring that all subcontractors are knowledgeable and follow the safety plan agreed upon by the Contractor and Contracting Officer.

1.8 ACCIDENT PREVENTION MANAGEMENT (JAN 1985 OCE)

a. Full-time, on-site, safety coverage shall provided by the Contractor.

b. The following conditions shall be met:

(1) The Contractor shall employ at the project site to cover all

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hours of work at least one Safety and Occupational Health person to manage the Contractor's accident program. Duties which are not germane to the safety program shall not be assigned to the Safety and Health person(s). The principal safety person shall report to and work directly for the Contractor's on-site top manager, higher level official, or corporate safety office. The Safety and Health person(s) shall have the authority to take immediate steps to correct unsafe or unhealthful conditions. The presence of a Safety and Health person will not abrogate safety responsibilities of other personnel.

(2) Qualifications for Safety and Health person(s).

(a) Shall have a degree in engineering or safety in at least a four year program from an accredited school; or

(b) Shall have legal registration as a Professional Engineer or a Certified Safety Professional and, in addition, shall have been engaged in safety and occupational health for at least 1 year of experience, no time being credited to this 1 year unless at least 50 percent of the time was devoted to safety and occupational health; or

(c) Shall have a degree other than that specified in (a) above and, in addition, shall have been engaged in safety and occupational health for at least 3 years, no time being credited to these 3 years unless at least 50 percent of the time each year was devoted to safety and occupational health; or

(d) In lieu of a degree, shall have been engaged in safety and occupational health for at least 5 years, no time being credited to these 5 years unless at least 50 percent of the time each year was devoted to safety and occupational health;

(e) First aid work is not a creditable experience.

(3) The name and qualifications of the nominated safety person(s) shall be furnished to the Contracting Officer for acceptability and a functional description of duties shall be provided prior to the pre-work conference.

#### 1.9 HAZARDOUS WASTE AND MATERIALS REPORTING

The Contractor shall notify the Contracting Officer upon encountering existing unanticipated material on the site which could jeopardize the safety of workers. The Government will be responsible for disposition of the waste if required.

Hazardous materials or waste transported onto or within the Post shall be reported to the Fire Department prior to movement on Government property.

#### 1.10 SPILL REPORTING

Upon verification of a release of any petroleum product over one gallon or any other hazardous waste or material, regardless of amount, the contractor shall notify the Post Fire Department at 911. The Post will determine the cleanup required. Upon release of a petroleum product under one gallon and no threat of fire or explosion exists, the Contractor shall clean the contaminated area to remove all contaminants. Contamination in excess of



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100 ppm of Total Petroleum Hydrocarbons shall be removed from the site. Costs of soil tests required as a result of spills shall be the Contractor's responsibility. Contaminated material shall be disposed of properly.

#### 1.11 RADIATION SOURCE COORDINATION

The Contractor shall coordinate with the Contracting Officer at least seven days prior to bringing any radiation source onto an Army installation.

#### 1.12 FIRE SAFETY

The Contractor shall use every precaution to avoid fires and shall, when directed by the Contracting Officer, provide fire-extinguishing equipment of his own in addition to that which exists in the building.

##### 1.12.1 Location of Fire Alarms and Telephone

The Contractor shall be briefed by the Contracting Officer or fire protection personnel on locations of fire alarms and telephones closest to the contract job site. The Contractor shall ensure that all subcontractors and their personnel have attended mandatory fire prevention and safety briefing prior to commencing any work under this contract. Prior to commencing work, the Contractor shall provide proof of the required training completion, such as safety meeting minutes and sign-in sheet, to the Contracting Officer.

##### 1.12.2 Fire Lanes

Approved fire lanes shall be kept open at all times, as required by the Government.

#### 1.13 VERIFICATION OF WORKING CONDITIONS

Government safety, fire protection, and Bioenvironmental Engineering (BE) officials may enter a Contractor's work place to verify working conditions of government personnel, provided the Contracting Officer authorizes such action. Accompaniment by the Contracting Officer or his representative is recommended.

#### 1.14 EXHAUST SPARK ARRESTORS

Exhaust spark arrestors shall be installed on all exhaust pipes of diesel fueled engines operating within or near hazardous areas to prevent sparks which could initiate combustion and/or explosions.

#### 1.15 CONFINED SPACE ENTRY PERMIT

The Contractor shall coordinate with the Contracting Officer on projects requiring a confined space entry permit. At a minimum, Contractor personnel shall not enter manholes, tunnels, tanks, or confined spaces until such entry complies with the requirements of OSHA 1926.21(b)(6). Post personnel will not provide entry testing or issue confined space entry permits to Contractor personnel until each person has passed the test.

#### 1.16 FIRE ALARM TESTING

The Contractor shall be responsible for testing and re-certification of all fire alarm systems that are modified by addition, deletion, or relocation

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of devices during construction. A copy of the certification record shall be made available to the Contracting Officer. All new fire alarm system installations shall be a loop system. The Contractor shall be responsible for forwarding a certification of completion to the Contracting Officer upon construction close-out procedures.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --



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SECTION 01 27 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 PAYMENT FOR MOBILIZATION AND PREPARATORY WORK (DEC 1991) (DFARS  
52.236-7003)

a. The Government will make payment to the Contractor under the procedures in this clause for mobilization and preparatory work under Bidding Schedule Item No. 1.

b. Payments will be made for actual payments by the Contractor on work preparatory to commencing actual work on the construction items for which payment is provided under the terms of this contract, as follows--

- (1) For construction plant and equipment exceeding \$25,000 in value per unit (as appraised by the Contracting Officer at the work site) acquired for the execution of the work;
- (2) Transportation of all plant and equipment to the site;
- (3) Material purchased for the prosecution of the contract, but not to be incorporated in the work;
- (4) Construction of access roads or railroads, camps, trailer courts, mess halls, dormitories or living quarters, field headquarters facilities, and construction yards;
- (5) Personal services; and
- (6) Hire of plant.

c. Requests for payment must include--

- (1) A certified account of the Contractor's actual expenditures;
- (2) Supporting documentation, including receipted bills or certified copies of payrolls and freight bills; and
- (3) The Contractor's certificate--
  - (i) Showing that it has acquired the construction plant, equipment, and material free from all encumbrances;
  - (ii) Agreeing that the construction plant, equipment, and material will not be removed from the site without the written permission of the Contracting Officer, and
  - (iii) Agreeing that structures and facilities prepared or erected for the prosecution of the contract work will be maintained and not dismantled prior to the completion and acceptance of the entire work, without the written permission of the Contracting Officer.

d. Upon receiving a request for payment, the Government will make payment, less any prescribed retained percentage, if--

- (1) The Contracting Officer finds the--
  - (i) Construction plant, material, equipment, and the mobilization and preparatory work performed are suitable and necessary to the efficient prosecution of the contract; and
  - (ii) Preparatory work has been done with proper economy and efficiency.
- (2) Payments for construction plant, equipment, material, and structures and facilities prepared or erected for prosecution of the contract work do

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not exceed--

(i) The Contractor's cost for the work performed less the estimated value upon completion of the contract; and

(ii) 100 percent of the cost to the contractor of any items having no appreciable salvage value; and

(iii) 75 percent of the cost to the contractor of items which do have an appreciable salvage value.

e. (1) Payments will continue to be made for Bidding Schedule Item No 1 "Mobilization and Preparatory Work", and all payments will be deducted from the contract price for this item, until the total deductions reduce this item to zero, after which no further payments will be made under this item. (2) If the total of payments so made does not reduce this item to zero, the balance will be paid to the Contractor in the final payment under the contract.

(3) The retained percentage will be paid in accordance with the CONTRACT CLAUSE entitled "Payments Under Fixed-Price Construction Contracts."

f. The Contracting Officer shall determine the value and suitability of the construction plant, equipment, materials, structures and facilities. The Contracting Officer's determinations are not subject to appeal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

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SECTION 01 32 01.00 10

PROJECT SCHEDULE  
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2005-10 (2005) Scheduling Requirements for Testing  
of Mechanical Systems in Construction

ER 1-1-11 (1995) Progress, Schedules, and Network  
Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Schedule; G

1.3 QUALITY ASSURANCE

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports. The authorized representative shall [be experienced in scheduling] [have previously developed, created, and maintained at least 2 electronic schedules for] projects similar in nature [and complexity] to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences, is required. The scheduling of construction design and construction is the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall

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also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool.

#### 3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

#### 3.1.2 Schedule Status Reports

Provide a Schedule Status Report on at least a monthly basis. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

#### 3.1.3 Default Terms

Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination, by the Contracting Officer, that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

### 3.2 BASIS FOR PAYMENT AND COST LOADING

Use the schedule as the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update, or qualified scheduling personnel, will result in the inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all required information will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the Project Schedule have been made. Activity cost loading shall be reasonable, as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN shall equal the value of the CLIN on the Schedule.

### 3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the Project Schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule.

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### 3.3.1 Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the Project Schedule. Prepare the Project Schedule using the Precedence Diagram Method (PDM).

### 3.3.2 Level of Detail Required

Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

#### 3.3.2.1 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

#### 3.3.2.2 Design and Permit Activities

Include design and permit activities with the necessary conferences and follow-up actions and design package submission dates. Include the design schedule in the project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This shall be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. The schedule shall include review and correction periods associated with each item.

#### 3.3.2.3 Procurement Activities

The schedule must include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

#### 3.3.2.4 Mandatory Tasks

The following tasks must be included and properly scheduled:

- a. Submission, review and acceptance of design packages.
- b. Submission of mechanical/electrical/information systems layout drawings.
- c. Submission and approval of O & M manuals.
- d. Submission and approval of as-built drawings.
- e. Submission and approval of 1354 data and installed equipment lists.
- f. Submission and approval of testing and air balance (TAB).



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- g. Submission of TAB specialist design review report.
- h. Submission and approval of fire protection specialist.
- i. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with ECB 2005-10.
- j. Air and water balancing.
- k. HVAC commissioning.
- l. Controls testing plan submission.
- m. Controls testing.
- n. Performance Verification testing.
- o. Other systems testing, if required.
- p. Contractor's pre-final inspection.
- q. Correction of punchlist from Contractor's pre-final inspection.
- r. Government's pre-final inspection.
- s. Correction of punch list from Government's pre-final inspection.
- t. Final inspection.

#### 3.3.2.5 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, approvals, design reviews, environmental permit approvals by State regulators, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

#### 3.3.2.6 Activity Responsibility Coding (RESP)

Assign responsibility Code for all activities to the Prime Contractor, Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

#### 3.3.2.7 Activity Work Area Coding

Assign Work Area code to activities based upon the work area in which the

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activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew, from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

#### 3.3.2.8 Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by the Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and, therefore, liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code.

#### 3.3.2.9 Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

#### 3.3.2.10 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities based upon the phase of work in which the activity occurs. Code activities to either a Design Phase or a Construction Phase. Code fast track design and construction phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall be identified with a single project phase and have only one Phase of Work code.

#### 3.3.2.11 Category of Work Coding (CATW)

Assign Category of Work Code to all Activities based upon the category of work to which the activity belongs. Category of Work Code must include, but is not limited to: design, design submittal, design reviews, review conferences, permits, construction submittals, construction submittal approvals, Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start-Up, Test and Turnover. Assign a Category of Work Code to each activity. Each activity shall have only one Category of Work Code.

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### 3.3.2.12 Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 01 USACE QUALITY CONTROL. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

### 3.3.3 Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is received by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

#### 3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" (or NTP). The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

#### 3.3.3.2 Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero fee float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

#### 3.3.3.3 Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, the Contractor shall identify those activities that it intends to

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accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

#### 3.3.4 Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

##### 3.3.4.1 Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

##### 3.3.4.2 End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

##### 3.3.4.3 Phase "X" Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

#### 3.3.5 Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

#### 3.3.6 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer.

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### 3.3.7 Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish (SF) relationships.

### 3.3.8 Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

### 3.3.9 Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

## 3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

### 3.4.1 Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3).

### 3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days

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after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer. Include in the design-build schedule detailed design and permitting activities, including but not limited to identification of individual design packages, design submission, reviews and conferences; permit submissions and any required Government actions; and long lead item acquisition prior to design completion. Also cover in the preliminary design-build schedule the entire construction effort with as much detail as is known at the time but, as a minimum, include all construction start and completion milestones, and detailed construction activities through the dry-in milestone, including all activity coding and cost loading. Include the remaining construction, including cost loading, but it may be scheduled summary in nature. As the design proceeds and design packages are developed, fully detail the remaining construction activities concurrent with the monthly schedule updating process. Constrain construction activities by Government acceptance of associated designs. When the design is complete, incorporate into the then approved schedule update all remaining detailed construction activities that are planned to occur after the dry-in milestone.

#### 3.4.3 Design Package Schedule Submission

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

#### 3.4.4 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made. Update the schedule to include detailed, lower WBS level construction activities as the design progresses, but not later than the submission of the final, un-reviewed design submission for each separate design package. The Contracting Officer may require submission of detailed schedule activities for any distinct construction that is started prior to submission of a final design submission, if such activity is authorized.

#### 3.4.5 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: [www.rmssupport.com](http://www.rmssupport.com). The SDEF format is as follows:

| Field | Activity Code | Length | Description                                       |
|-------|---------------|--------|---|
| 1     | WRKP          | 3      | Workers per Day                                   |
| 2     | RESP          | 4      | Responsible Party (e.g. GC, subcontractor, USACE) |
| 3     | AREA          | 4      | Area of Work                                      |

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| Field | Activity |        |  |
|-------|----------|--------|--|
|       | Code     | Length | Description  |
| 4     | MODF     | 6      | Modification or REA number                           |
| 5     | BIDI     | 6      | Bid Item (CLIN)                                      |
| 6     | PHAS     | 2      | Phase of Work  |
| 7     | CATW     | 1      | Category of Work                                     |
| 8     | FOW1     | 10     | Feature of Work (used up to 10 characters in length) |
| 9     | FOW2     | 10     | Feature of Work (used up to 20 characters in length) |
| 10    | FOW3     | 10     | Feature of Work (used up to 30 characters in length) |

### 3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

#### 3.5.1 Data CD's

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file name. Each schedule shall have a unique file name as determined by the Contractor.

#### 3.5.2 Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

#### 3.5.3 Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

#### 3.5.4 Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

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#### 3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

#### 3.5.4.2 Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order by activity number.

#### 3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

#### 3.5.4.4 Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has furnished a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

#### 3.5.5 Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

##### 3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

##### 3.5.5.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

##### 3.5.5.3 Critical Path

Clearly show the critical path.

##### 3.5.5.4 Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.



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#### 3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

### 3.6 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity to review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

#### 3.6.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

#### 3.6.2 Status of Activities

Update information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting.

##### 3.6.2.1 Start and Finish Dates

Accurately show the status of the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

##### 3.6.2.2 Remaining Duration

Update the estimated RD for all incomplete activities independent of

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Percent Complete. Remaining Durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

#### 3.6.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

#### 3.6.2.4 Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

#### 3.6.2.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

### 3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

#### 3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other

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factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

### 3.7.2 Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

### 3.7.3 Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

### 3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

### 3.9 WEEKLY PROGRESS MEETINGS

- a. The Government and the Contractor shall meet weekly (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two

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weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

### 3.10 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

### 3.11 TRANSFER OF SCHEDULE DATA INTO RMS/QCS

The Contractor shall download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

-- End of Section --



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SECTION 01 33 00.00 10

SUBMITTAL PROCEDURES

02/09

PART 1 GENERAL

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations samples remaining upon completion of the work.

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to a notice to proceed. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

Certificates of insurance  
Surety bonds  
List of proposed subcontractors  
List of proposed products  
Construction Progress Schedule  
Network Analysis Schedule (NAS)  
Submittal register

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Schedule of prices  
Health and safety plan  
Work plan  
Quality control (QC) plan  
Environmental protection plan

#### SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

#### SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

#### SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

#### SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

#### SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

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Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

#### SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

#### SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

#### SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

#### SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance



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and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

#### SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

#### 1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

#### 1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor QC approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with this section.

#### SD-01 Preconstruction Submittals

Submittal register; G

### 1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

#### 1.3.1 Designer of Record Approved (DA)

Designer of Record (DOR) approval is required for extensions of design, critical materials, any deviations from the solicitation, the accepted proposal, or the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings." Contractor to provide the Government with the number of copies designated hereinafter of all DOR approved submittals. The Government may review any or all Designer of Record approved submittals for conformance to the Solicitation, Accepted Proposal and the completed design. The Government will review all submittals designated as deviating from the Solicitation or Accepted Proposal, as described below. Design submittals to be in accordance with Section [01 33 16.00 10] [\_\_\_\_\_] DESIGN AFTER AWARD. Generally, design submittals should be identified as SD-05 Design Data submittals.

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#### 1.3.2 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

#### 1.3.3 Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section [01 33 16.00 10] [\_\_\_\_\_] DESIGN AFTER AWARD covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section [01 33 16.00 10] [\_\_\_\_\_] DESIGN AFTER AWARD. Generally, design submittals should be identified as SD-05 Design Data submittals.

#### 1.3.4 Designer of Record Approved/Government Conformance Review (DA/CR)

##### 1.3.4.1 Deviations to the Accepted Design

Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the Contracting Officer's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if deemed necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

##### 1.3.4.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal.

#### 1.3.5 Designer of Record Approved/Government Approved (DA/GA)

In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where

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applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed deviation to the contract (the solicitation and/or the accepted proposal), which constitutes a change to the contract terms. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". The Government reserves the right to accept or reject any such proposed deviation at its discretion.

#### 1.3.6 Information Only

Submittals not requiring Government approval will be for information only. For Design-build construction all submittals not requiring Designer of Record or Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

#### 1.4 PREPARATION

##### 1.4.1 Transmittal Form

Use the attached sample transmittal form (ENG Form 4025) for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the QCS software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

#### 1.5 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. For design-build construction the Government will retain [ ] copies of information only submittals.

#### 1.6 VARIATIONS / SUBSTITUTION REQUESTS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

##### 1.6.1 Considering Variations

Discussion with Contracting Officer prior to submission, will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

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Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

#### 1.6.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals which include proposed deviations requested by the Contractor. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

#### 1.6.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

#### 1.6.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

### 1.7 SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 01.10 USACE QUALITY CONTROL SYSTEM (QCS). [The Government will provide the initial submittal register ] [in electronic format] [ with the following fields completed, to the extent that will be required by the Government during subsequent usage.]

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

[Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on

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which submittals are received and returned by the Government.]

The Designer of Record shall develop a complete list of submittals during design and identify required submittals in the specifications, and use the list to prepare the Submittal Register. The list may not be all inclusive and additional submittals may be required by other parts of the contract. The Contractor is required to complete the submittal register and submit it to the Contracting Officer for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. Coordinate the submit dates and need dates with dates in the Contractor prepared progress schedule. Submit monthly or until all submittals have been satisfactorily completed, updates to the submittal register showing the Contractor action codes and actual dates with Government action codes. Revise the submittal register when the progress schedule is revised and submit both for approval.

#### 1.7.1 Use of Submittal Register

Submit submittal register. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

[Column (a) Activity Number: Activity number from the project schedule.]

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

[Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.]

[Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.]

#### 1.7.2 Contractor Use of Submittal Register

Update the following fields[ in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor] with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

#### 1.7.3 Approving Authority Use of Submittal Register

Update the following fields[ in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor].

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

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Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

#### 1.7.4 Contractor Action Code and Action Code

Entries for columns (j) and (o), are to be used as follows (others may be prescribed by Transmittal Form):

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

#### 1.7.5 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

#### 1.8 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 14 calendar days will be allowed and shown on the register for review and approval of submittals for [food service equipment] [and] [refrigeration and HVAC control systems].

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A".
- c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.
- d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

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#### 1.8.1 Government Reviewed Design

The Government will review all design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16.00 10 DESIGN AFTER AWARD covers the design submittal and review process in detail. Government review is required for deviation from the completed design. Review will be only for conformance with the contract requirements. Included are only those construction submittals for which the Designer of Record design documents do not include enough detail to ascertain contract compliance. The Government may, but is not required, to review extensions of design such as structural steel or reinforcement shop drawings.

#### 1.9 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

- a. Note date on which submittal was received.
- b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph entitled "Review Notations" and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. A minimum of two (2) copies of the approved submittal will be retained by the Contracting Officer and a minimum of three copies of the submittal will be returned to the Contractor. If the Government performs a conformance review of other Designer of Record approved submittals, the submittals will be so identified and returned, as described above.

#### 1.10 DISAPPROVED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

#### 1.11 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or acceptance will not relieve the Contractor of the

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responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for [dimensions, the design of adequate connections and details, and the satisfactory construction of all work] [design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work]. After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

#### 1.12 CONSTRUCTION COLOR BOARDS

##### 1.12.1 Description

Contractor shall prepare in binder format a series of construction color boards which illustrate by means of physical samples the materials and finishes that are integral to the exterior and interior finishes of the completed facility. These items include, but are not limited to: masonry, architectural concrete, metal panels, siding and roofing, interior and exterior trim, paints, wall coverings, floor coverings and base, ceiling materials, plastic laminates, casework, stained woodwork, toilet partition and accessory finishes, etc. Color board samples (especially of exterior finish materials) are not required to be of full size or thickness but must represent the full range of color, texture, and finish of the materials. Carpet samples shall not be less than 3" by 5" or larger if needed to indicate complete color and design.

##### 1.12.2 Format

Material samples shall be mounted on 8 1/2" x 11" modules with the project title and name of the installation placed in the lower right corner of each module. Sample board modules shall consist of protection (mat) boards of sufficient strength and thickness to support and anchor samples. Large or heavy samples shall be anchored with mechanical fasteners or epoxy resin cement. "Rubber cement" or other contact adhesives shall not be used. Eight and one half by eleven inch (8- 1/2" x 11") boards shall be three-hole punched and placed in 3-ring binders. 8-1/2" x 11" boards may be securely taped together at edges to provide a "fold-out" display presentation provided overall dimensions of fold-out materials does not exceed 25-1/2" x 33". Each 3-ring binder shall be identified on its spine with the following information: project fiscal year, project title, contract number, installation name where project is to be built and date of submittal (month and year). Presentation shall be organized in a logical manner to facilitate an orderly and speedy review. Sample items and color names shall be identified with names that correspond to names shown on the project color and finish schedule. If not readily apparent from the color and finish schedule, the sample boards shall be annotated to reflect what areas or surfaces of the facility are to receive the finishes shown

#### 1.13 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.



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Match the approved samples for Materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapproved any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

#### 1.14 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required Designer of Record or required Government approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

#### 1.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

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|   |
|---|
| CONTRACTOR  |
| (Firm Name)   |
| _____ Approved  |
| _____ Approved with corrections as noted on submittal data and/or<br>attached sheets(s) |
| SIGNATURE: _____  |
| TITLE: _____  |
| DATE: _____   |

For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record are to stamp and sign to certify that the submittal meets contract requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --



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| TITLE AND LOCATION<br>(CIF) Central Issue Facility for Ft. Sill |                    |                               |   |                                      |                           |                    |                    |                   |                | CONTRACTOR                                 |                            |                            |             |   |         |                |     |
| TRANSMITTAL<br>ACTIVITY NO                                      | SPEC<br>SECTION NO | DESCRIPTION<br>ITEM SUBMITTED | PARAGRAPH #                             | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                    |                    | CONTRACTOR ACTION |                | APPROVING AUTHORITY                        |                            |                            |             | MAILED TO CONTR/ DATE RCD FRM APPR AUTH | REMARKS |                |     |
|   |                    |                               |   |                                      | SUBMIT                    | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE       | DATE OF ACTION | DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD FROM OTH REVIEWER | ACTION CODE |   |         | DATE OF ACTION |     |
| (a)   | (b)                | (c)                           | (d)                                     | (e)                                  | (f)                       | (g)                | (h)                | (i)               | (j)            | (k)  | (l)                        | (m)                        | (n)         | (o)                                     | (p)     | (q)            | (r) |
|   | 00100              |                               | Item Requiring Submittal                |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Item Requiring Submittal                |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Item Requiring Submittal                |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Item Requiring Submittal                |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Item Requiring Submittal                |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   | 01 04 00           |                               | SD-09 Manufacturer's Field Reports      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Survey Field Notes                      | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   | 01 10 00           |                               | SD-01 Preconstruction Submittals        |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Contractor Health and Safety Plan       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | SD-07 Certificates                      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Report of Accident and Exposure         | 1.5                                  |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Data                                    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Report of Accident and Exposure         | 1.5                                  |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Data                                    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Monthly Hazardous Material Usage Report | 1.6                                  |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Monthly Hazardous Usage Report          |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Certification of Completion             | 1.26                                 |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   | 01 32 01.00 10     |                               | SD-01 Preconstruction Submittals        |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Project Schedule                        | 3.4                                  | G                         |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   | 01 33 00.00 10     |                               | SD-01 Preconstruction Submittals        |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   |                    |                               | Submittal register                      | 1.9                                  | G                         |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |
|   | 01 35 10           |                               | SD-02 Shop Drawings                     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |     |

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| TITLE AND LOCATION<br>(CIF) Central Issue Facility for Ft. Sill |                    |                               |                                  |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     | CONTRACTOR   |  |
| TRANSMITTAL<br>ACTIVITY NO                                      | SPEC<br>SECTION NO | DESCRIPTION<br>ITEM SUBMITTED | PARAGRAPH#                       | GOVT OR<br>CLASSIFICATION | CONTRACTOR:<br>SCHEDULE DATES |                          |                          | CONTRACTOR<br>ACTION |                   | DATE FWD<br>TO APPR<br>AUTH/<br>DATE RCD<br>FROM<br>CONTR | APPROVING AUTHORITY |     |     | MAILED<br>TO<br>CONTR/<br>DATE RCD<br>FRM APPR<br>AUTH | REMARKS |     |              |  |
|   |                    |                               |                                  |                           | SUBMIT                        | APPROVAL<br>NEEDED<br>BY | MATERIAL<br>NEEDED<br>BY | ACTION CODE          | DATE OF<br>ACTION |   | (m)                 | (n) | (o) |  |         | (p) |              |  |
| (a)   | (b)                | (c)                           | (d)                              | (e)                       | (f)                           | (g)                      | (h)                      | (i)                  | (j)               | (k)   | (l)                 | (m) | (n) | (o)  | (p)     | (q) | (r)          |  |
|   | 01 35 10           |                               | Work Zones                       |                           | G R E                         |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Decontamination Facilities       |                           | G R E                         |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | SD-03 Product Data               |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Exposure Monitoring/Air          |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Sampling Program                 |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Site Control Log                 |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   | 01 35 26.00 10     |                               | SD-01 Preconstruction Submittals |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Accident Prevention Plan (APP)   | 1.7                       | G A                           |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Activity Hazard Analysis (AHA)   | 1.8                       | G A                           |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Crane Critical Lift Plan         | 1.7.1                     | G A                           |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Crane Operators                  | 1.6.1.5                   | G A                           |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | SD-06 Test Reports               |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Reports                          | 1.12                      |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Accident Reports                 | 1.12.1                    |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Monthly Exposure Reports         | 1.12.3                    |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Crane Reports                    | 1.12.4                    |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Gas Protection                   |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | SD-07 Certificates               |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Confined Space Entry Permit      | 1.9                       |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Hot work permit                  | 1.9                       |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | License Certificates             |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Certificate of Compliance        | 1.12.5                    |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   | 01 44 00           |                               | SD-01 Preconstruction Submittals |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Quality Control Plan             | 3.2                       | G                             |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   | 01 45 35           |                               | SD-07 Certificates               |                           |                               |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |
|   |                    |                               | Special Inspector                | 1.3                       | G                             |                          |                          |                      |                   |   |                     |     |     |  |         |     |              |  |

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APPENDIX F

| SUBMITTAL REGISTER  |                    |                               |  |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     | CONTRACT NO.   |         |
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| TITLE AND LOCATION<br>(CIF) Central Issue Facility for Ft. Sill |                    |                               |  |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     | CONTRACTOR   |         |
| TRANSMITTAL<br>ACTIVITY NO                                      | SPEC<br>SECTION NO | DESCRIPTION<br>ITEM SUBMITTED | PARAGRAPH<br>#                               | GOVT OR<br>CLASSIFICATION | (e)  | (f) | CONTRACTOR:<br>SCHEDULE DATES |                          |                          | CONTRACTOR<br>ACTION |                      | DATE FWD<br>TO APPR<br>AUTH/ | APPROVING AUTHORITY |     |     |     | MAILED<br>TO<br>CONTR/<br>DATE RCD<br>FRM APPR<br>AUTH | REMARKS |
|   |                    |                               |  |                           |      |     | SUBMIT                        | APPROVAL<br>NEEDED<br>BY | MATERIAL<br>NEEDED<br>BY | ACTION               | DATE<br>OF<br>ACTION |                              | (m)                 | (n) | (o) | (p) |  |         |
| (a)   | (b)                | (c)                           | (d)  |                           |      |     | (g)                           | (h)                      | (i)                      | (j)                  | (k)                  | (l)                          | (m)                 | (n) | (o) | (p) | (q)  | (r)     |
|   | 01 45 35           |                               | Quality Assurance Plan                       | G                         | 1.4  |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   | 01 50 02.00 10     |                               | SD-01 Preconstruction Submittals             |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Site Plan                                    | G RE                      | 1.17 |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   | 01 57 20.00 02     |                               | SD-01 Preconstruction Submittals             |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Environmental Protection Plan                | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Storm Water Pollution Prevention Plan (SWP3) | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Waste Management Plan                        | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Spray Painting Plan                          | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Restoration Plan                             | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Notice of Intent (ODEQ Form 640-571)         | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Notice of Termination                        | G RE                      |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | (NOT)(ODEQ Form 640-572)                     |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | SD-07 Certificates                           |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Maintenance of Pollution Control             |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Training Certification                       |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   | 01 70 00.00 10     |                               | SD-10 Operation and Maintenance              |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Data   |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Operation and Maintenance                    | G                         |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Manuals                                      |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | SD-11 Closeout Submittals                    |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Record Drawings                              | G                         |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   | 01 74 19           |                               | SD-01 Preconstruction Submittals             |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | Waste Management Plan                        | G                         | 1.6  |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |
|   |                    |                               | SD-11 Closeout Submittals                    |                           |      |     |                               |                          |                          |                      |                      |                              |                     |     |     |     |  |         |

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| ACTIVITY NO   | TRANSMITTAL NO | SPEC SECT | DESCRIPTION<br>ITEM SUBMITTED   | PARAGRAPH# | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                    |                    | CONTRACTOR ACTION |                | DATE FWD TO APPR AUTH/ | APPROVING AUTHORITY        |                       |             |                | MAILED TO CONTR/ DATE RCD FRM APPR AUTH | REMARKS      |  |
|   |                |           |                                 |            |                                      | SUBMIT                    | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE       | DATE OF ACTION |                        | DATE FWD TO OTHER REVIEWER | RCD FROM OTH REVIEWER | ACTION CODE | DATE OF ACTION |   |              |  |
| (a)   | (b)            | (c)       | (d)                             | (e)        | (f)                                  | (g)                       | (h)                | (i)                | (j)               | (k)            | (l)                    | (m)                        | (n)                   | (o)         | (p)            | (q)                                     | (r)          |  |
|   | 01 74 19       |           | Records                         | 1.7        |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 08 20       |           | SD-02 Shop Drawings             |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Precast Manholes                | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | SD-05 Design Data               |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Precast Manholes                | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 08 40       |           | SD-05 Design Data               |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Castings                        | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | SD-02 Shop Drawings             |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Castings                        | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 08 50       |           | SD-03 Product Data              |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Valve Boxes                     | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Meter Boxes                     | 2.2        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Meter Vaults                    | 2.6        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Item Requiring Submittal        |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 22 20       |           | SD-05 Design Data               |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Flowable fill mix design report |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 41 00       |           | SD-07 Certificates              |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Demolition plan                 | 1.10       | G AE                                 |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Notifications                   | 1.4.1      | G PO                                 |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 50 10       |           | SD-02 Shop Drawings             |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Ductile Iron Pipe               | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | SD-05 Design Data               |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Ductile Iron Pipe               | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | SD-07 Certificates              |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   |                |           | Ductile Iron Pipe               | 2.1        | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |
|   | 02 50 30       |           | SD-07 Certificates              |            |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |              |  |

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PREVIOUS EDITION IS OBSOLETE

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CONTRACT NO.

SUBMITTAL REGISTER

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|   | 02 81 00       |           | Notices of Non-Compliance and Notices of Violation | 3.2       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-06 Test Reports                                 |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Recordkeeping                                      | 3.7       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Spill Response                                     | 3.8       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Exception Reports                                  | 3.7       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Packaging Notifications                            | 2.1.1     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-07 Certificates                                 |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Certification                                      | 1.3.3     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Security Plan                                      | 3.2.4     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Transportation and Disposal                        | 1.3.1     | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Coordinator  |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Training   | 1.3.2     | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | EPA Off-Site Policy                                | 3.2.2     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Certificates of Disposal                           | 3.2.5     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Shipping Documents and                             | 3.2.3     | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Packagings Certification                           |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Waste Minimization                                 | 3.6       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 03 20 01.00 10 |           | SD-02 Shop Drawings                                |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Reinforcement                                      | 3.1       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-07 Certificates                                 |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Reinforcing Steel                                  | 2.3       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 03 30 53       |           | SD-03 Product Data                                 |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Air-Entraining Admixture                           | 2.1.3.1   |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Water-Reducing or Retarding                        | 2.1.3.3   |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Admixture  |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |

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|   |                |                               |  |                                      | SUBMIT                    | APPROVAL<br>NEEDED<br>BY | MATERIAL<br>NEEDED<br>BY | ACTION CODE       | DATE OF<br>ACTION |                              |                                  | (m)                 | (n) | (o) |  |         | (p)          |  |
| (a)   | (b)            | (c)                           | (d)  | (e)                                  | (f)                       | (g)                      | (h)                      | (i)               | (j)               | (k)                          | (l)                              | (m)                 | (n) | (o) | (p)  | (q)     | (r)          |  |
|   | 03 30 53       |                               | Curing Materials   | 2.1.12                               |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Reinforcing Steel  | 2.1.5                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Batching and Mixing Equipment                            |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Conveying and Placing Concrete                           | 3.2                                  |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Formwork   | 2.1.9                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Mix Design Data  | 2.2                                  |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Fly Ash  | 2.2                                  |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | SD-06 Test Reports                                       |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Aggregates   | 2.1.2                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Concrete Mixture Proportions                             | 1.4.3                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Compressive Strength Testing                             | 3.12                                 |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Slump  | 3.12                                 |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | SD-07 Certificates                                       |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Cementitious Materials                                   | 2.1.1                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | CPG for recycled materials or<br>appropriate Waiver Form | 1.6.1                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Aggregates   | 2.1.2                                |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   | 26 08 00       |                               | SD-06 Test Reports                                       |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Acceptance tests and inspections                         | 3.1                                  | G                         |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | SD-07 Certificates                                       |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Qualifications   | 1.4.1                                | G                         |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Acceptance test and inspections<br>procedure             | 1.4.3                                | G                         |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   | 26 28 01.00 10 |                               | SD-03 Product Data                                       |                                      |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Equipment  | 2.1                                  |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |
|   |                |                               | Installation   | 3.2                                  |                           |                          |                          |                   |                   |                              |                                  |                     |     |     |  |         |              |  |

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|   | 26 28 01.00 10 |           | SD-06 Test Reports               |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Field Testing                    | 3.3         |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | SD-07 Certificates               |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Devices and Equipment            | 1.6         |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   | 26 56 00       |           | SD-02 Shop Drawings              |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Luminaire drawings               | 1.4.1.1     | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Poles                            | 1.4.1.2     | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | SD-03 Product Data               |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Local/Regional Materials         | 1.6.1       |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Energy Efficiency                | 1.6.3       |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Luminaires                       | 2.2         | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Lamps                            | 2.2.1       | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Ballasts                         | 2.2.2       | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Lighting contactor               | 2.3         | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Time switch                      | 2.4         | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Photocell switch                 | 2.5         | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Aluminum poles                   | 2.6.2       | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Brackets                         | 2.7         |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | SD-05 Design Data                |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Design Data for luminaires       | 1.4.3       | G                                 |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | SD-06 Test Reports               |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Operating test                   | 3.2         |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | SD-10 Operation and Maintenance  |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Data                             |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   |                |           | Operational Service              | 1.9         |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |
|   | 31 00 00       |           | SD-01 Preconstruction Submittals |             |                                   |                           |                    |                    |                   |                |                        |                            |                            |             |                |   |              |  |

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|   | 31 00 00       |           | Shoring                                 | 3.5       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Dewatering Work Plan                    | 1.9       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-03 Product Data                      |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Utilization of Excavated Materials      | 3.9       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Opening of any Excavation or Borrow Pit | 3.4       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Shoulder Construction                   | 3.15      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-06 Test Reports                      |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Testing                                 | 3.18      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Borrow Site Testing                     | 2.1       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-07 Certificates                      |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Testing                                 | 3.18      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 31 11 00       |           | SD-03 Product Data                      |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Nonsaleable Materials                   | 3.6.2     | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-04 Samples                           |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Tree wound paint                        | 2.1       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Herbicide                               | 2.2       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 32 01 19       |           | SD-03 Product Data                      |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Manufacturer's Recommendations          |           | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Equipment                               | 1.6       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-04 Samples                           |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Materials                               | 1.5       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 32 05 33       |           | SD-01 Preconstruction Submittals        |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Integrated Pest Management Plan         | 2.4       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |

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| TRANSMITTAL<br>ACTIVITY NO                                      | SPEC SECT | DESCRIPTION<br>ITEM SUBMITTED | PARAGRAPH                        | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                          |                          | CONTRACTOR ACTION |                   | DATE FWD<br>TO APPR<br>AUTH/ | APPROVING AUTHORITY              |                                  |             |                   | MAILED<br>TO<br>CONTR/<br>DATE RCD<br>FRM APPR<br>AUTH | REMARKS |              |  |
|   |           |                               |                                  |                                      | SUBMIT                    | APPROVAL<br>NEEDED<br>BY | MATERIAL<br>NEEDED<br>BY | ACTION CODE       | DATE OF<br>ACTION |                              | DATE FWD<br>TO OTHER<br>REVIEWER | DATE RCD<br>FROM OTH<br>REVIEWER | ACTION CODE | DATE OF<br>ACTION |  |         |              |  |
| (a)   | (b)       | (c)                           | (d)                              | (e)                                  | (f)                       | (g)                      | (h)                      | (i)               | (j)               | (k)                          | (l)                              | (m)                              | (n)         | (o)               | (p)  | (q)     | (r)          |  |
|   | 32 05 33  |                               | SD-03 Product Data               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Local/Regional Materials         | 1.6.1                                |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Fertilizer                       | 2.1                                  | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Hose                             | 2.2.1                                |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Mulches Topdressing              | 2.3                                  |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Organic Mulch Materials          | 2.3.2                                |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | SD-07 Certificates               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Maintenance inspection report    | 3.5.1                                |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Plant quantities                 | 3.5.2                                | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | SD-10 Operation and Maintenance  |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Data                             |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Maintenance                      | 1.7                                  |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | SD-11 Closeout Submittals        |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Tree, staking and guying removal | 3.5.3                                |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
| 32 11 23  |           |                               | SD-03 Product Data               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Plant, Equipment, and Tools      | 1.7                                  |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Waybills and Delivery Tickets    | 1.8                                  |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | SD-06 Test Reports               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Sampling and Testing             | 1.5                                  | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Field Density Tests              | 1.5.2.4                              | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
| 32 12 10  |           |                               | SD-06 Test Reports               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Sampling and Testing             | 3.7                                  |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
| 32 12 16  |           |                               | SD-03 Product Data               |                                      |                           |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Mix Design                       | 2.3                                  | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Contractor Quality Control       | 3.10                                 | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |
|   |           |                               | Material Acceptance              | 3.11                                 | G                         |                          |                          |                   |                   |                              |                                  |                                  |             |                   |  |         |              |  |

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|   | 32 12 16  |                               | SD-04 Samples              |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Asphalt Cement Binder      | 2.2                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Aggregates                 | 2.1                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | SD-06 Test Reports         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Aggregates                 | 2.1                                  | G                         |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | QC Monitoring              | 3.10.3.10                            |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | SD-07 Certificates         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Asphalt Cement Binder      | 2.2                                  | G                         |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Testing Laboratory         | 3.6                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   | 32 13 14  |                               | SD-03 Product Data         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Equipment                  | 1.7                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Paving                     | 3.4                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Mixture Proportions        | 2.11                                 | G                         |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   | 32 16 13  |                               | SD-03 Product Data         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Concrete                   | 2.1                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | SD-06 Test Reports         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Field Quality Control      | 3.8                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   | 32 92 19  |                               | SD-03 Product Data         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Wood cellulose fiber mulch | 2.5.3                                |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Fertilizer                 | 2.4                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | SD-06 Test Reports         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Topsoil composition tests  | 2.2.3                                |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | SD-07 Certificates         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | seed                       | 2.1                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   | 32 92 23  |                               | SD-03 Product Data         |                                      |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |
|   |           |                               | Fertilizer                 | 2.5                                  |                           |                          |                          |                   |                   |   |                                  |                                  |             |  |         |                   |              |  |

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| TITLE AND LOCATION<br>(CIF) Central Issue Facility for Ft. Sill |                |         |   |            |                                      |                           |                    |                    |                   | CONTRACTOR     |  |                            |                            |             |   |         |                |
| ACTIVITY NO   | TRANSMITTAL NO | SPECIES | DESCRIPTION<br>ITEM SUBMITTED             | PARAGRAPH# | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                    |                    | CONTRACTOR ACTION |                | APPROVING AUTHORITY                        |                            |                            |             | MAILED TO CONTR/ DATE RCD FRM APPR AUTH | REMARKS |                |
|   |                |         |   |            |                                      | SUBMIT                    | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE       | DATE OF ACTION | DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD FROM OTH REVIEWER | ACTION CODE |   |         | DATE OF ACTION |
| (a)   | (b)            | (c)     | (d)                                       | (e)        | (f)                                  | (g)                       | (h)                | (i)                | (j)               | (k)            | (l)  | (m)                        | (n)                        | (o)         | (p)                                     | (q)     | (r)            |
|   | 32 92 23       |         | SD-06 Test Reports                        |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Topsoil composition tests                 |            | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | SD-07 Certificates                        |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | sods                                      | 2.1        | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 32 93 00       |         | SD-01 Preconstruction Submittals          |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | State Landscape Contractor's License      | 1.4.3      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Time Restrictions and Planting Conditions | 1.6        |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | SD-03 Product Data                        |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Local/Regional Materials                  | 1.8.1      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Peat                                      |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Composted Derivatives                     |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Rotted Manure                             | 2.3.11     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Mulch Materials                           |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Weed Control Fabric                       |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Mulch                                     | 2.8        | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Ground Stakes                             | 2.9.1.2    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Ground Stakes                             | 2.9.1.2    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Hose                                      | 2.14.1     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Fertilizer                                | 2.5        |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Staking Material                          | 2.9.1      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Metal anchors                             | 2.9.7      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Antidesiccants                            | 2.11       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | Photographs                               | 1.4.4      | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |         | SD-04 Samples                             |            |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |



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| TRANSMITTAL<br>ACTIVITY NO                                      | SPEC<br>SECTION NO | DESCRIPTION<br>ITEM SUBMITTED | PARAGRAPH #                      | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                          |                          | CONTRACTOR ACTION |                   | DATE FWD<br>TO APPR<br>AUTH/ | DATE RCD<br>FROM<br>CONTR | APPROVING AUTHORITY              |                                  |             | MAILED<br>TO<br>CONTR/<br>DATE RCD<br>FRM APPR<br>AUTH | REMARKS |                   |  |
|   |                    |                               |                                  |                                      | SUBMIT                    | APPROVAL<br>NEEDED<br>BY | MATERIAL<br>NEEDED<br>BY | ACTION CODE       | DATE OF<br>ACTION |                              |                           | DATE FWD<br>TO OTHER<br>REVIEWER | DATE RCD<br>FROM OTH<br>REVIEWER | ACTION CODE |  |         | DATE OF<br>ACTION |  |
| (a)   | (b)                | (c)                           | (d)                              | (e)                                  | (f)                       | (g)                      | (h)                      | (i)               | (j)               | (k)                          | (l)                       | (m)                              | (n)                              | (o)         | (p)  | (q)     | (r)               |  |
|   | 32 93 00           |                               | Mulch                            | 2.8                                  | G                         |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | SD-06 Test Reports               |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Topsoil composition tests        | 1.4.1                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Topsoil composition tests        | 2.2.4                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Percolation Test                 | 1.4.5                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | SD-07 Certificates               |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Forest Stewardship Council       | 1.8.3                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | (FSC) Certification              |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Nursery certifications           | 1.4.2                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Nursery certifications           | 2.1.1                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | SD-10 Operation and Maintenance  |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Data                             |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Plastic Identification           | 1.8.2                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   | 32 96 00           |                               | SD-01 Preconstruction Submittals |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | State Landscape Contractor's     | 1.4.1                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | License & Tree Relocation        |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | References                       |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Permits                          | 1.4.2                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Photographs                      | 1.4.3                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | SD-02 Shop Drawings              |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Transplanting Plan               | 1.4.4                                | G                         |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | SD-03 Product Data               |                                      |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Equipment                        | 1.4.4                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Gypsum                           | 2.2.9                                |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Mulches Topdressing              | 2.3                                  |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |
|   |                    |                               | Ground Stakes                    | 2.4.1.2                              |                           |                          |                          |                   |                   |                              |                           |                                  |                                  |             |  |         |                   |  |

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|   |                |           |                                |         |                                      | SUBMIT                    | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE       | DATE OF ACTION |                        | DATE FWD TO OTHER REVIEWER | RCD FROM OTH REVIEWER | ACTION CODE | DATE OF ACTION |   |         |              |  |
| (a)   | (b)            | (c)       | (d)                            | (e)     | (f)                                  | (g)                       | (h)                | (i)                | (j)               | (k)            | (l)                    | (m)                        | (n)                   | (o)         | (p)            | (q)                                     | (r)     |              |  |
|   | 32 96 00       |           | Ground Stakes                  | 2.4.1.2 |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Hose                           | 2.6.1   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Local/Regional Materials       | 1.12.1  |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Peat                           | 2.2.5   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Composted Derivatives          | 2.2.8   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Rotted Manure                  | 2.2.11  |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Organic Mulch Materials        | 2.3.2   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Staking Material               | 2.4.1   | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | SD-06 Test Reports             |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Soil Test                      | 1.4.6   | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Percolation Test               | 1.4.7   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | SD-07 Certificates             |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Forest Stewardship Council     | 1.12.2  | G                                    |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | (FSC) Certification            |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   | 33 40 01       |           | SD-03 Product Data             |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Placing Pipe                   | 3.3     |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | SD-04 Samples                  |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Pipe for Culverts and Storm    | 2.1     |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Drains                         |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | SD-07 Certificates             |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Resin Certification            | 2.1.10  |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Resin Certification            | 2.1.11  |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Pipeline Testing               | 3.8     |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Hydrostatic Test on Watertight | 2.7     |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Joints                         |         |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |
|   |                |           | Determination of Density       | 3.7.5   |                                      |                           |                    |                    |                   |                |                        |                            |                       |             |                |   |         |              |  |

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| SUBMITTAL REGISTER  |                |           |                                 |           |                                      |                           |                    |                    |                   | CONTRACT NO.   |  |                            |                            |             |   |         |                |
|---|----------------|-----------|---------------------------------|-----------|--------------------------------------|---------------------------|--------------------|--------------------|-------------------|----------------|--|----------------------------|----------------------------|-------------|---|---------|----------------|
| TITLE AND LOCATION<br>(CIF) Central Issue Facility for Ft. Sill |                |           |                                 |           |                                      |                           |                    |                    |                   | CONTRACTOR     |  |                            |                            |             |   |         |                |
| ACTIVITY NO   | TRANSMITTAL NO | SPEC SECT | DESCRIPTION<br>ITEM SUBMITTED   | PARAGRAPH | GOVT OR A/E REVIEW<br>CLASSIFICATION | CONTRACTOR SCHEDULE DATES |                    |                    | CONTRACTOR ACTION |                | APPROVING AUTHORITY                        |                            |                            |             | MAILED TO CONTR/ DATE RCD FRM APPR AUTH | REMARKS |                |
|   |                |           |                                 |           |                                      | SUBMIT                    | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE       | DATE OF ACTION | DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD FROM OTH REVIEWER | ACTION CODE |   |         | DATE OF ACTION |
| (a)   | (b)            | (c)       | (d)                             | (e)       | (f)                                  | (g)                       | (h)                | (i)                | (j)               | (k)            | (l)  | (m)                        | (n)                        | (o)         | (p)                                     | (q)     | (r)            |
|   | 33 40 01       |           | Frame and Cover for Gratings    | 2.3.7     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 33 70 02.00 10 |           | SD-02 Shop Drawings             |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Detail Drawings                 | 1.4.1     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | As-Built Drawings               | 1.4.2     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-03 Product Data              |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Nameplates                      | 2.2       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Material and Equipment          | 2.1       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Installation Requirements       | 3.2       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-06 Test Reports              |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Factory Tests                   | 2.17      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Field Testing                   | 3.12      |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Operating Tests                 | 3.12.13   |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Cable Installation              | 3.3.1.4   |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-07 Certificates              |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Material and Equipment          | 2.1       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Cable Joints                    | 3.4       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Installation Engineer           | 3.13.2    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | SD-10 Operation and Maintenance |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Data                            |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Operation and Maintenance       | 3.13.1    |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Manuals                         |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   | 33 71 01       |           | SD-03 Product Data              |           |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Conductors                      | 2.6       |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Insulators                      | 2.5       | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Wood Poles                      | 2.2.1     |                                      |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |
|   |                |           | Nameplates                      | 2.24      | G                                    |                           |                    |                    |                   |                |  |                            |                            |             |   |         |                |





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## SECTION 01 35 10

### SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST)

#### PART 1 GENERAL

The Contractor is hereby notified that the site is contaminated. Refer to Section 01 56 01 ENVIRONMENTAL PROTECTION, Part I General, for a description of the site.

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### CODE OF FEDERAL REGULATIONS (CFR)

|             |   |
|-------------|---|
| 29 CFR 1904 | Recording and Reporting Occupational Injuries and Illnesses |
| 29 CFR 1910 | Occupational Safety and Health Standards                    |
| 29 CFR 1926 | Safety and Health Regulations for Construction              |

##### U.S. ARMY CORPS OF ENGINEERS (USACE)

|            |  |
|------------|--|
| EM 385-1-1 | (2006) Safety -- Safety and Health Requirements Manual |
|------------|--|

##### 1.2 DESCRIPTION OF WORK

This section requires contractors to implement practices and procedures for working safely and in compliance with OSHA and USACE regulation while performing cleanup activities on uncontrolled hazardous waste sites. The section provides additional requirements for implementing the accident prevention provision of EM 385-1-1 and specifies a Site Safety and Health Plan (SSHP) which shall satisfy the requirements for submission of a separate Accident Prevention Plan (APP) as required by EM 385-1-1. The requirements shall apply to work performed in both "contaminated" and "clean" areas.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Work Zones; G, RE

Drawings including initial work zone boundaries: Exclusion Zone (EZ), including restricted and regulated areas; Contamination

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Reduction Zone (CRZ); and Support Zone (SZ).

Decontamination Facilities; G, RE

Drawings showing the layout of the personnel and equipment decontamination areas.

#### SD-03 Product Data

Exposure Monitoring/Air Sampling Program

Personnel exposure monitoring/sampling results.

Site Control Log

Record of each entry and exit into the site, as specified.

### 1.4 REGULATORY REQUIREMENTS

Environmental work performed under this contract shall comply with EM 385-1-1, applicable Federal, state, and local safety and occupational health laws and regulations. This includes, but is not limited to OSHA requirements in 29 CFR 1910, especially Section .120, "Hazardous Waste Site Operations and Emergency Response" and 29 CFR 1926, especially Section .65, "Hazardous Waste Site Operations and Emergency Response". Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

### 1.5 PRECONSTRUCTION SAFETY CONFERENCE

Fourteen (14) days prior to initiating field activities, a Preconstruction Safety Conference shall be conducted between the applicable contractor, regulatory, and Corps of Engineers employees.

### 1.6 SAFETY AND HEALTH PROGRAM

The Contractor shall develop and implement a Safety and Health Program (SHP) which incorporates requirements in OSHA standards 29 CFR 1910, Section .120 (b) and 29 CFR 1926, Section .65 (b) and section 01.A.07 of EM 385-1-1. The Safety and Health Program shall address the items in paragraph (b) of 29 CFR 1910.120/29 CFR 1926.65 and Appendix A of EM 385-1-1 in corporate specific detail. These items are: Signature Sheet; Background Information; Statement of Safety and Health Policy; Responsibilities and Lines of Authority; Subcontractors and Suppliers; Training; Safety and Health Inspections; Safety and Health Expectations, Incentives programs and Compliance; Accident Reporting; Medical Surveillance/Medical Support; Personal Protective Equipment; Standard Operating Procedures and Corporate Plans supporting occupational safety and health.

### 1.7 SITE SAFETY AND HEALTH PLAN

The Contractor shall prepare a Site Safety and Health Plan (SSHP) covering onsite work to be performed by the Contractor and all subcontractors. A Certified Industrial Hygienist shall be responsible for the development, implementation and oversight of the SSHP. The SSHP shall establish in

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detail the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The SSHP shall address site specific safety and health requirements and procedures based upon site specific conditions. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial SSHP is prepared and submitted. Therefore, the SSHP shall address, in as much details as possible, anticipated tasks, their related hazards and anticipated control measures. Additional details shall be included in the activity hazard analyses as described in the paragraph entitled ACTIVITY HAZARD ANALYSES.

#### 1.7.1 Acceptance and Modifications

Prior to submittal, the SSHP shall be signed and dated by the Certified Industrial Hygienist and the Site Superintendent. The SSHP shall be submitted for review 30 days prior to the Preconstruction Safety Conference. Deficiencies in the SSHP will be discussed at the preconstruction safety conference, and the SSHP shall be revised to correct the deficiencies and resubmitted for acceptance. Onsite work shall not begin until the plan has been accepted. A copy of the written SSHP shall be maintained onsite. Changes and modifications to the accepted SSHP shall be made with the knowledge and concurrence of the Certified Industrial Hygienist, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, the Site Safety and Health Officer (SSHO) shall bring such hazard to the attention of the Certified Industrial Hygienist, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted SSHP shall be cause for stopping of work until the matter has been rectified.

#### 1.7.2 Availability

The SSHP shall be made available in accordance with 29 CFR 1910, Section .120 (b) (1) (v) and 29 CFR 1926, Section .65 (b) (1) (v).

#### 1.7.3 Elements Topics Required by 29 CFR 1910

Elements topics required by 29 CFR 1910, Section .120 (b) (4) 29 CFR 1926, Section .65 (b) (4) and the Accident Prevention Plan as described in Appendix A of EM 385-1-1 and those described in this section shall be addressed to the SSHP. Where the use of a specific topic is not applicable to the project, the SSHP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given to the topic.

### 1.8 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

#### 1.8.1 Project/Site Conditions

Refer to Section 01 56 01 ENVIRONMENTAL PROTECTION, Part 1, General, for project/site conditions, site history, and site contamination information.

#### 1.8.2 Plan Requirements

The SSHP shall include a site description and contamination



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characterization section that addresses the following items:

- a. Description of site location, topography, size and past uses of the site.
- b. A list of contaminants which may present occupational health and safety hazards. This list shall be created by evaluation the analytical results of this section and by researching sources of information from past site investigation activities. Chemical names, concentration ranges, media in which found, locations onsite, and estimated quantities/volumes to be impacted by site work shall be included if known. The contamination characterization shall be reviewed and revised if new chemicals are identified as work progresses.

#### 1.9 HAZARD/RISK ANALYSIS

The SSHP shall include a safety and health hazard/risk analysis for each site task and operation to be performed. The hazard/risk analysis shall provide information necessary for determining safety and health procedures, equipment, and training to protect onsite personnel, the environment, and the public. Available site information shall be reviewed when preparing the Hazard/Risk Analysis section of the SSHP. The following items, at a minimum, shall be addressed.

##### 1.9.1 Site Tasks and Operations (Work plan)

The SSHP shall include a comprehensive section that addresses the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives. Based on the type of construction required, the following is a list of anticipated major site tasks and operations to be performed. The list may not be complete, therefore the list shall be expanded and/or revised, during preparation of the SSHP as necessary.

- a. Mobilization,
- b. Site preparation,
- c. Excavation of soil,
- d. Evacuation of water from excavations,
- e. Construction within excavations,
- f. Backfilling of soil,
- g. Decontamination,
- h. Water and soil waste handling.

##### 1.9.2 Hazards

The following potential hazards may be encountered during site work. These are not complete lists; therefore, they shall be expanded and/or revised as necessary during preparation of the SSHP.

##### 1.9.2.1 Safety Hazards

Potential safety hazards that may be encountered during site work consist of general construction hazards and hazards associated with HTRW site activities. The Contractor shall include in the Hazard/Risk Analysis section of the SSHP a description of all anticipated safety hazards and hazard control methods including protection exposure standards in accordance with all Federal, state and local laws and regulations.

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#### 1.9.2.2 Chemical Hazards

Potential chemical hazards that may be encountered during site work are discussed in the Section 01 56 01 ENVIRONMENTAL PROTECTION, Part 1, General.

The Hazard/Risk Analysis section of the SSHP shall describe the chemical, physical, and toxicological properties of contaminants, sources and pathways of employee exposures, anticipated onsite and offsite exposure level potentials, and regulatory (including Federal, state, and local) or recommended protective exposure standards. The SSHP shall also address employee exposure to hazardous substances brought onsite, and shall comply with the requirements of 29 CFR 1910, Section .1200 and 29 CFR 1926, Section .59, Hazard Communication.

#### 1.9.2.3 Physical Hazards

Potential physical hazards that may be encountered by the Contractor during site work include, but are not limited to, cuts, punctures, noise, back strain, temperature stress, traffic and hazards associated with the operation and use of excavation and heavy construction equipment. All site activities and equipment operation will comply with applicable Federal, state, local, and project requirements including COE Health and Safety Requirements Manual EM 385-1-1.

#### 1.9.2.4 Radiological Hazards

Radiological hazards are not anticipated for this project; however, in the event that radiological hazards are encountered or suspected, site operations in impacted work areas will be terminated until the SSHP and work practices are amended to address the associated hazards.

#### 1.9.2.5 Biological Hazards

Potential biological hazards that may be encountered during site work include, but are not limited to, animal and plant hazards. The Hazard/Risk Analysis section of the SSHP shall describe all anticipated biological hazards and hazard control methods including protective exposure standards in accordance with all Federal, state, and local laws and regulations.

#### 1.9.3 Action Levels

##### 1.9.3.1 General

Action levels shall be established for the situations listed below, at a minimum. The action levels and required actions (engineering controls, changes in PPE, etc.) shall be presented in the SSHP in both text and tabular form.

- a. Implementation of engineering controls and work practices.
- b. Upgrade or downgrade in level of personal protective equipment.
- c. Work stoppage and/or emergency evacuation of onsite personnel.
- d. Prevention and/or minimization of public exposures to hazards created by site activities.

##### 1.9.3.2 Confined Space Entry

Entry into and work in a confined space will not be allowed when oxygen readings are less than 19.5 percent or greater than 23.5 percent or if the Lower Flammable Limit (LFL) reading is greater than 10 percent, unless

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these conditions are adequately addressed in the confined space entry program. In addition, action levels for toxic atmospheres shall be determined.

#### 1.10 ACTIVITY HAZARD ANALYSIS

Thirty (30) days prior to beginning each major phase of work, an Activity Hazard Analysis shall be prepared by the Contractor and submitted to the Contracting Officer for review and approval. The format shall be in accordance with EM 385-1-1, Figure 1-1. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to begin work. The analysis shall define the activities to be performed and identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the Activity Hazard Analysis has been approved and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the Government onsite representatives. The Activity Hazard Analysis shall be continuously reviewed and, when appropriate, revised to address changing site conditions or operations, with the approval of the Certified Industrial Hygienist, the Site Superintendent, and the Contracting Officer. Activity Hazard Analyses shall be attached to and become part of the SSHP.

#### 1.11 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

An organizational structure shall be developed by the Contractor that sets forth lines of authority (chain of command), responsibilities, and communication procedures concerning site safety, health, and emergency response. This organizational structure shall cover management, supervisors and employees of the Contractor and subcontractors. This structure shall include the means for coordinating and controlling work activities of subcontractors and suppliers. The SSHP shall include a description of this organizational structure as well as qualifications and responsibilities of each of the following individuals. The Contractor shall obtain the Contracting Officer's approval before replacing any member of the Safety and Health staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

##### 1.11.1 Site Superintendent

A Site Superintendent shall be designated by the Contractor. The Site Superintendent shall be responsible to implement the SSHP, shall have the authority to direct work performed under this contract and shall verify compliance of the work.

##### 1.11.2 Certified Industrial Hygienist

Certified Industrial Hygienist shall be as required by Section 01 10 00 SAFETY. The name, qualifications (including education summary and documentation, certification and work experience summary shall be included in the SSHP.

1) The Certified Industrial Hygienist shall:

a. Be responsible for the development, implementation, oversight, and enforcement of the SSHP.

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- b. Sign and date the SSHP prior to submittal.
- c. Conduct initial site-specific training.
- d. Be available for emergencies.
- e. Provide consultation as needed to ensure the SSHP is fully implemented.
- f. Coordinate any modifications to the SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.
- g. Provide continued support for upgrading/downgrading of the level of personal protection.
- h. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.
- i. Review accident reports and results of daily inspections.
- j. Serve as a member of the Contractor's quality control staff.

#### 1.11.3 Site Safety and Health Officer

An individual and one alternate shall be designated the Site Safety and Health Officer (SSHO). The name, qualifications (education and training summary and documentation), and work experience of the Site Safety and Health Officer and alternate shall be included in the SSHP.

1) The SSHO shall have the following qualifications:

- a. A minimum of 1 year experience in implementing safety and health programs at hazardous waste sites where Level C personal protective equipment was required.
- b. Documented experience in construction techniques and construction safety procedures.
- c. Working knowledge of Federal and state occupational safety and health regulations.
- d. Specific training in personal and respiratory protective equipment program implementation, confined space program oversight, and in the proper use of air monitoring instruments, and air sampling methods including monitoring for ionizing radiation.

2) The Site Safety and Health Officer shall:

- a. Assist and represent the Certified Industrial Hygienist in onsite training and the day to day onsite implementation and enforcement of the accepted SSHP.
- b. Be assigned to the site on a full time basis for the duration of field activities.
- c. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the SSHP including, but not limited to, activity hazard analyses, air monitoring, monitoring for ionizing radiation, use of PPE, decontamination,

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site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.

d. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

e. Consult with and coordinate any modifications to the SSHP with the Certified Industrial Hygienist, the Site Superintendent, and the Contracting Officer.

f. Serve as a member of the Contractor's quality control staff on matters relating to safety and health.

g. Conduct accident investigations and prepare accident reports.

h. Review results of daily quality control inspections and document safety and health findings into the Daily Safety Inspection Log.

i. In coordination with site management and the Certified Industrial Hygienist, recommend corrective actions for identified deficiencies and oversee the corrective actions.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

### 3.1 WORK AREA AIR MONITORING

Air monitoring will be conducted during excavation and construction activities activities and activities that require excavation at or below where groundwater is encountered.

#### 3.1.1 Direct Reading Air Monitoring

During excavation activities and construction where excavation will be at or below the elevation of groundwater, direct reading air monitoring shall be performed by the Contractor to determine exposure to works and if contamination is present.

### 3.2 CONTAINERIZATION OF EXCAVATED MATERIALS

Refer to Section 01 56 01 for additional requirements.

#### 3.2.1 Materials Excavated 6-Foot Below Grade or Less

Materials excavated 6-foot below grade or less shall not require containerization unless the groundwater table is encountered. If groundwater is encountered, the Contractor shall containerize and test excavated material and groundwater. Materials shall be reused if possible or disposed of off Base after testing. The Contractor shall containerize, test, store, and dispose of off Base any water pumped out of excavations (groundwater or rainwater). Disposal shall be in accordance with all Federal, State, and local laws and regulations.

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### 3.2.2 Materials Excavated Below 6-Foot

The Contractor shall containerize, store, and test any material excavated below 6 foot. Materials shall be reused or disposed of as appropriate after testing. The Contractor shall containerize, test, store, and dispose of off Base any water pumped out of excavations (groundwater or rainwater). Disposal shall be in accordance with all Federal, State, and local laws and regulations.

### 3.2.3 Containers

The Contractor shall be responsible for providing the containers and storage for excavated materials and groundwater. The Contractor shall be responsible for containerization, testing, storage, and appropriate disposal of containerized excavated materials, groundwater, and rainwater pumped from excavations. Disposal shall be off Base in accordance with all Federal, State, and local laws and regulations.

-- End of Section --



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SECTION 01 35 26.00 10

GOVERNMENTAL SAFETY REQUIREMENTS

**CESWT 09/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

|                  |  |
|------------------|--|
| ASSE/SAFE A10.32 | (2004) Fall Protection   |
| ASSE/SAFE A10.34 | (2001; R 2005) Protection of the Public on<br>or Adjacent to Construction Sites              |
| ASSE/SAFE Z359.1 | (2007) Safety Requirements for Personal<br>Fall Arrest Systems, Subsystems and<br>Components |

ASME INTERNATIONAL (ASME)

|             |   |
|-------------|---|
| ASME B30.22 | (2005) Articulating Boom Cranes                 |
| ASME B30.3  | (2004) Construction Tower Cranes                |
| ASME B30.5  | (2004) Mobile and Locomotive Cranes             |
| ASME B30.8  | (2004) Floating Cranes and Floating<br>Derricks |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

|          |   |
|----------|---|
| NFPA 10  | (2006; Errata 2006) Standard for Portable<br>Fire Extinguishers       |
| NFPA 51B | (2003) Fire Prevention During Welding,<br>Cutting, and Other Hot Work |
| NFPA 70  | (2007) National Electrical Code - 2008<br>Edition                     |
| NFPA 70E | (2004; AMD 2004) Electrical Safety in the<br>Workplace                |

U.S. ARMY CORPS OF ENGINEERS (USACE)

|            |  |
|------------|--|
| EM 385-1-1 | (2003) Safety -- Safety and Health<br>Requirements |
|------------|--|

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

|             |  |
|-------------|--|
| 29 CFR 1910 | Occupational Safety and Health Standards |
|-------------|--|



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|                 |  |
|-----------------|--|
| 29 CFR 1910.146 | Permit-required Confined Spaces                |
| 29 CFR 1926     | Safety and Health Regulations for Construction |
| 29 CFR 1926.500 | Fall Protection                                |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00.00 10 SUBMITTAL PROCEDURES:

Government acceptance is required for submittals with a "G, A" designation.

### SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, A  
Activity Hazard Analysis (AHA); G, A  
Crane Critical Lift Plan; G, A  
Proof of qualification for Crane Operators; G, A

### SD-06 Test Reports

#### Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Monthly Exposure Reports

Crane Reports

Gas Protection

### SD-07 Certificates

Confined Space Entry Permit

Hot work permit

License Certificates

[ Certificate of Compliance (Crane)]

Submit one copy of each permit/certificate attached to each Daily [Production] [Quality Control] Report.

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### 1.3 DEFINITIONS

a. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

b. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even though provided by a physician or registered personnel.

c. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

d. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

[ e. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).]

### 1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with USACE EM 385-1-1, and the following [federal, state, and local,] [host nation] laws, ordinances, criteria, rules and regulations [\_\_\_\_\_]. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

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## 1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

### 1.5.1 Personnel Qualifications

#### 1.5.1.1 Site Safety and Health Officer (SSHO)

Provide a site Safety and Health Officer (SSHO) at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The Contractor Quality Control (QC) person [ cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.] [ can be the SSHO on this project.] Meet the following requirements within the SSHO:

- [ Level 1:  
Worked on similar projects.  
10-hour OSHA construction safety class or equivalent within last 3 years.  
Competent person training as needed.]
- [ Level 2:  
A minimum of 3 years safety work on similar project.  
30-hour OSHA construction safety class or equivalent within last 3 years.  
Competent person training as needed.] [40 hour Construction Hazard Awareness Course provided by the Guam Contractors Association.]
- [ Level 3:  
A minimum of 5 years safety work on similar projects.  
30-hour OSHA construction safety class or equivalent within the last 5 years.  
An average of at least 24 hours of formal safety training each year for the past 5 years.  
Competent person training as needed.] [40 hour Construction Hazard Awareness Course provided by the Guam Contractors Association].
- [ Level 4:  
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.  
30-hour OSHA construction safety class or equivalent within the last 5 years.  
An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following [4] areas of competency:  
[Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents];  
[Personal protective equipment and clothing to include selection, use and maintenance]; [\_\_\_\_\_]; [40 hour Construction Hazard Awareness Course provided by the Guam Contractors Association]].
- [ Level 5:  
An Associate Safety Professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health & Safety Technician (CHST).  
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.  
30-hour OSHA construction safety class or equivalent within the last 5 years.

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An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following [4] areas of competency: [Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents]; [Personal protective equipment and clothing to include selection, use and maintenance]; [\_\_\_\_\_]; [40 hour Construction Hazard Awareness Course provided by the Guam Contractors Association]].

[ Level 6: A  
Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH).  
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.  
30-hour OSHA construction safety class or equivalent within the last 5 years.  
An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following [4] areas of competency: [Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents]; [Personal protective equipment and clothing to include selection, use and maintenance]; [\_\_\_\_\_]; [40 hour Construction Hazard Awareness Course provided by the Guam Contractors Association]].

[1.5.1.2 Certified Safety Professional (CSP) and/or Certified Industrial hygienist (CIH)

Provide a [Certified Safety Professional (CSP)] [and] [Certified Industrial Hygienist (CIH)] at the work site to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The [CSP] [and] [or] [CIH] shall be the safety and occupational health "competent person" as defined by USACE EM 385-1-1. [The [CSP and/or CIH] shall have no other duties than safety and occupational health management, inspections, and/or industrial hygiene.]

]1.5.1.3 Associate Safety professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health and Safety Technician (CHST)

Provide [a/an] [Associate Safety Professional (ASP)] [Certified Safety Trained Supervisor (STS)] [and/or] [Construction Health & Safety Technician (CHST)] at the work site to perform safety management, surveillance, inspections, and safety enforcement for the Contractor. The [ASP] [STS] [and/or] [CHST] shall be the safety and occupational health "competent person" as defined by USACE EM 385-1-1. The [ASP] [STS] [and/or] [CHST] shall be at the work site at all times whenever work or testing is being performed and shall conduct and document daily safety inspections. The [ASP] [STS] [and/or] [CHST] shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

]1.5.1.4 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix G. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators

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(i.e., union, a government agency, or and organization that tests and qualifies crane operators). Provide proof of current qualification.

#### 1.5.2 Personnel Duties

##### 1.5.2.1 Site Safety and Health Officer (SSHO)

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily [production] [quality control] report.
- b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.
- c. Maintain applicable safety reference material on the job site.
- d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.
- e. Implement and enforce accepted APPS and AHAs.
- f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.
- g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties will result in dismissal of the superintendent and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

[1.5.2.2 [Certified Safety Professional (CSP)] [Certified Industrial Hygienist (CIH)] [Associate Safety Professional (ASP)] [Certified Safety Trained Supervisor (STS)] [and/or] [Certified Construction Health & Safety Technician (CHST)]]

- a. Perform safety and occupational health management, surveillance, inspections, and safety enforcement for the project.
- b. Perform as the safety and occupational health "competent person" as defined by USACE EM 385-1-1.
- c. Be on-site [at all times] [at least weekly] [at least monthly] [\_\_\_\_\_] whenever work or testing is being performed.
- d. Conduct and document safety inspections.
- e. shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

If the [CSP] [CIH] [ASP] [STS] [CHST] is appointed as the SSHO all duties of that position shall also be performed.

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### ]1.5.3 Meetings

#### 1.5.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

d. The functions of a Preconstruction conference may take place at the Post-Award Kickoff meeting for Design Build Contracts.

#### 1.6 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated CSP and/or CIH.

Submit the APP to the Contracting Officer [15] [\_\_\_\_\_] calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this

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contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any hazard become evident, stop work in the area, secure the area, and develop a plan to remove the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the [Contracting Officer's] [resident engineer's] office and at the job site. Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

#### 1.6.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

- [ a. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.C.18. and the following:
  - (1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.550(g).
  - (2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.]
- [ b. Occupant Protection Plan. The safety and health aspects of lead-based paint removal, prepared in accordance with Section 02 82 16.00 20 LEAD BASED PAINT HAZARD ABATEMENT, TARGET HOUSING & CHILD OCCUPIED FACILITIES.]
- [ c. Lead Compliance Plan. The safety and health aspects of lead work, prepared in accordance with Section 02 83 13.00 20 LEAD IN CONSTRUCTION. ]
- [ d. Asbestos Hazard Abatement Plan. The safety and health aspects of asbestos work, prepared in accordance with Section 02 82 14.00 10 ASBESTOS ABATEMENT.]
- [ e. Site Safety and Health Plan. The safety and health aspects prepared in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.]

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- [ f. PCB Plan. The safety and health aspects of Polychlorinated Biphenyls work, prepared in accordance with Sections 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENALS and 02 61 23 REMOVAL AND DISPOSAL OF PCB CONTAMINATED SOILS.]
- [ g. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.]
- [ h. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.]

#### 1.7 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1. Submit the AHA for review at least [15 ] [\_\_\_\_\_] calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

#### 1.8 DISPLAY OF SAFETY INFORMATION

Within [1] [\_\_\_\_\_] calendar days after commencement of work, erect a safety bulletin board at the job site. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

- a. Confined space entry permit.
- b. Hot work permit.

#### 1.9 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

#### 1.10 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

#### 1.11 REPORTS

##### 1.11.1 Accident Reports

- a. Conduct an accident investigation for recordable injuries and



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illnesses, and property damage accidents resulting in at least \$2,000 in damages, to establish the root cause(s) of the accident, complete the USACE Accident Report Form 3394 and provide the report to the Contracting Officer within [5][\_\_\_\_\_] calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

- [ b. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form.]

#### 1.11.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than [four hours][\_\_\_\_], after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

#### 1.11.3 Monthly Exposure Reports

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

#### 1.11.4 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix H and as specified herein with Daily Reports of Inspections.

#### [1.11.5 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 section 16 and Appendix H. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used.[ For cranes at DOD activities in foreign countries, certify that the crane and rigging gear conform to the appropriate host country safety standards.] Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices

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(e.g., anti-two block devices). Post certifications on the crane.

#### ]1.12 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the [Fire Division] [\_\_\_\_\_]. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency [Fire Division] [\_\_\_\_\_] phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE [FIRE DIVISION] [\_\_\_\_\_] IMMEDIATELY.

#### 1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

#### 1.14 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

- a. Secure outside equipment and materials and place materials that could be damaged in protected areas.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

#### PART 2 PRODUCTS

Not used.

#### PART 3 EXECUTION

##### 3.1 CONSTRUCTION AND/OR OTHER WORK

##### 3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The Contracting Officer, upon written request by the

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Contractor, may consider exceptions to the use of any of the above excluded materials.

### 3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If [additional] material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within [14][\_\_\_\_\_] calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

### 3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least [15][\_\_\_\_\_] days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer [ and the[ Installation representative][ Public Utilities representative]] to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

### 3.3 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

Contracting Officer will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout tags.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

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Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

#### 3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

#### 3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer.

### 3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

#### 3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, section 21.A.16.

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### 3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.H. and 05.I. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

#### 3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

#### 3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

##### a. Low Sloped Roofs:

(1) For work within 1.8 m (6 feet) of an edge, on low-slope roofs, Protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets.

(2) For work greater than 1.8 m (6 feet) from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

#### 3.4.4 Existing Anchorage

Certified (or re-certified) by a qualified person for fall protection

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existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with ASSE/SAFE Z359.1. Existing horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

#### 3.4.5 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

#### 3.4.6 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

#### 3.4.7 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

### 3.5 SCAFFOLDING

#### [3.5.1 Stilts

The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is prohibited.

### ]3.6 EQUIPMENT

#### 3.6.1 Material Handling Equipment

- a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
- c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

#### 3.6.2 Weight Handling Equipment

- a. Equip cranes and derricks as specified in EM 385-1-1, section 16.
- b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the

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manufacturer's recommended procedures.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 section 11 and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

### 3.7 EXCAVATIONS

Perform soil classification by a competent person in accordance with 29 CFR 1926.

#### 3.7.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

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### 3.7.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every 30.5 m (100 feet) if parallel within 1.5 m (5 feet) of the excavation.

### 3.7.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

### 3.7.4 Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

## 3.8 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

## 3.9 ELECTRICAL

### 3.9.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any



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energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

### 3.9.2 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70.

### 3.10 WORK IN CONFINED SPACES

Comply with the requirements in Section 06.I of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

-- End of Section --

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SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

05/09

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)  
38800 Country Club Drive  
Farmington Hills, MI 48331  
Ph: 248-848-3700  
Fax: 248-848-3701  
E-mail: [bkstore@concrete.org](mailto:bkstore@concrete.org)  
Internet: <http://www.concrete.org>

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)  
1200 G Street, NW, Suite 500  
Washington, D.C. 20005  
Ph: 202-628-6380  
Fax: 202-393-5453  
Internet: <http://www.atis.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)  
444 North Capital Street, NW, Suite 249  
Washington, DC 20001  
Ph: 202-624-5800  
Fax: 202-624-5806  
E-Mail: [info@aaashto.org](mailto:info@aaashto.org)  
Internet: <http://www.aashto.org>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)  
One East Wacker Drive  
Chicago, IL 60601-1802  
Ph: 312-670-2400  
Fax: 312-670-5403  
Publications: 800-644-2400

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E-mail: [pubs@aisc.org](mailto:pubs@aisc.org)  
Internet: <http://www.aisc.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)  
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Washington, DC 20036  
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Fax: 202-293-9287  
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Internet: <http://www.ansi.org/>

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Fax: 301-459-8077  
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Internet: <http://www.asse.org>

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New York, NY 10016  
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ASPHALT INSTITUTE (AI)  
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Internet: <http://www.asphaltinstitute.org>

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)  
600 North 18th Street  
P.O. Box 2641  
Birmingham, AL 35291  
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Fax: 205-257-2540  
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Fax: 610-832-9555  
E-mail: [service@astm.org](mailto:service@astm.org)  
Internet: <http://www.astm.org>

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)  
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Ph: 847-517-1200  
Fax: 847-517-1206  
Internet: <http://www.crsi.org/>

FM GLOBAL (FM)  
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P.O. Box 7500  
Johnston, RI 02919  
Ph: 401-275-3000  
Fax: 401-275-3029  
E-mail: [information@fmglobal.com](mailto:information@fmglobal.com)  
Internet: <http://www.fmglobal.com>

FOREST STEWARDSHIP COUNCIL (FSC)  
1155 30th Street NW  
Suite 300  
Washington, DC 20007  
Ph: 202.342.0413  
Fax: 202.342.6589  
E-mail: [info@fscus.org](mailto:info@fscus.org)  
Internet: <http://www.fscus.org>

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)  
120 Wall Street, 17th Floor  
New York, NY 10005  
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Fax: 212-248-5018  
E-mail: [iesna@iesna.org](mailto:iesna@iesna.org)  
Internet: <http://www.iesna.org>

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Fax: 305-264-8088  
Internet: <http://www.iata.org>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)  
445 Hoes Lane  
Piscataway, NJ 08855-1331  
Ph: 732-981-0060  
Fax: 732-981-1712  
E-mail: [customer-services@ieee.org](mailto:customer-services@ieee.org)  
Internet: <http://www.ieee.org>

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)  
P.O. Box 687  
106 Stone Street

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Morrison, CO 80465  
Ph: 303-697-8441  
Fax: 303-697-8431  
E-mail: [neta@netaworld.org](mailto:neta@netaworld.org)  
Internet: <http://www.netaworld.org>

L.H. BAILEY HORTORIUM (LHBH)  
Dept of Plant Biology  
c/o Cornell University  
228 Plant Science Building  
Ithaca, NY 14853  
Ph: 607-255-4477  
Internet: <http://www.plantbio.cornell.edu/Hort.php>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)  
1300 North 17th Street, Suite 1752  
Rosslyn, VA 22209  
Ph: 703-841-3200  
Fax: 703-841-5900  
E-mail: [webmaster@nema.org](mailto:webmaster@nema.org)  
Internet: <http://www.nema.org/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)  
1 Batterymarch Park  
Quincy, MA 02169-7471  
Ph: 617-770-3000  
Fax: 617-770-0700  
E-mail: [webmaster@nfpa.org](mailto:webmaster@nfpa.org)  
Internet: <http://www.nfpa.org>

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)  
900 Spring Street  
Silver Spring, MD 20910  
Ph: 301-587-1400  
Fax: 301-585-4219  
Internet: <http://www.nrmca.org>

TURFGRASS PRODUCERS INTERNATIONAL (TPI)  
2 East Main Street  
East Dundee, IL 60118  
Ph: 847-649-5555 or 800-405-8873  
Fax: 847-649-5678  
E-mail: [info@turfgrasssod.org](mailto:info@turfgrasssod.org)  
Internet: <http://www.turfgrasssod.org>

UNDERWRITERS LABORATORIES (UL)  
333 Pfingsten Road  
Northbrook, IL 60062-2096  
Ph: 847-272-8800  
Fax: 847-272-8129  
E-mail: [customerexperiencecenter@us.ul.com](mailto:customerexperiencecenter@us.ul.com)  
Internet: <http://www.ul.com/>

U.S. ARMY CORPS OF ENGINEERS (USACE)  
Order CRD-C DOCUMENTS from:  
U.S. Army Engineer Waterways Experiment Station  
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E-mail: [mtc-info@erdc.usace.army.mil](mailto:mtc-info@erdc.usace.army.mil)  
Internet: <http://www.wes.army.mil/SL/MTC/handbook.htm>

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or <http://www.hnd.usace.army.mil/techinfo/engpubs.htm>

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U.S. DEPARTMENT OF AGRICULTURE (USDA)  
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Fax: 704-852-4189  
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[www.daps.dla.mil](http://www.daps.dla.mil)

- - - - - Detail Series Documents - - - - -

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Ariel Rios Building

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Internet: <http://www.epa.gov>

--- Some EPA documents are available only from:

National Technical Information Service (NTIS)

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Springfield, VA 22161

Ph: 703-605-6585

Fax: 703-605-6900

E-mail: [info@ntis.gov](mailto:info@ntis.gov)

Internet: <http://www.ntis.gov>

U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

500 C Street, SW

Washington, D.C. 20472

Ph: 1-800-621-FEMA

Internet: <http://www.fema.gov>

U. S. GREEN BUILDING COUNCIL (USGBC)

1015 18th Street, NW, Suite 508

Washington, D.C. 20036

Ph: 202-828-7422

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E-mail: [info@usbc.org](mailto:info@usbc.org)

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Internet: <http://www.gpoaccess.gov>

-- End of Section --





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SECTION 01 44 00

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

|             |  |
|-------------|--|
| ASTM C 1077 | (2005a) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation                       |
| ASTM D 3666 | (2004) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials  |
| ASTM D 3740 | (1999c) Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction |
| ASTM E 329  | (2000a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction   |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G.

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed and before the pre-construction conference, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a

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CQC Plan or another interim plan containing the additional features of work to be started.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "INSPECTION OF CONSTRUCTION." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both on-site and off-site, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for construction and construction-related activities at the site.

3.2 QUALITY CONTROL PLAN

3.2.1 General

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC plan shall include, as a minimum, the following to cover all construction operations, both on-site and off-site, including work by subcontractors, fabricators, suppliers and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC system manager who shall report to the project manager or someone higher in the Contractor's organization. Project manager in this context shall mean the individual with responsibility for the overall management of the project including quality and production.
- b. The name, qualifications (in resume format), duties,

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responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off-site fabricators, suppliers and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL DESCRIPTIONS.

e. Control, verification and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

### 3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.4 Notification of Changes

After acceptance of the QC plan, the Contractor shall notify the Contracting Officer in writing a minimum of seven calendar days prior to any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

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### 3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the Quality Control Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both on-site and off-site work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

### 3.4 QUALITY CONTROL ORGANIZATION

#### 3.4.1 Personnel Requirements

The requirements for the CQC organization area a CQC system manager, and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC Staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

#### 3.4.2 CQC System Manager

The Contractor shall identify an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience similar to this contract or a construction person with a minimum of 10 years in related work. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. The CQC Manager shall be assigned no other duties in addition to quality control. Period of absence may not exceed two weeks at any one time, and not more than 45 workdays during a calendar year. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the system manager's absence. The requirements for the alternate will be the same as for the designated CQC manager.

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### 3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC system Manager for the following areas: electrical, mechanical, structural, architectural, materials technician, and submittals clerk. These individuals shall be directly employed by the prime Contractor and may not be employed by a supplier or sub-contractor on this project; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no other duties other than quality control. Physical presence shall begin when each discipline of work begins on site. In addition, these individuals shall be a part of the submittal review process and shall sign the applicable submittal prior to Submission to the Government.

#### Experience Matrix

| Area |               | Qualifications   |
|------|---------------|--|
| a.   | Mechanical    | Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience         |
| b.   | Electrical    | Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience |
| c.   | Structural    | Graduate Structural Engineer with 2 yrs experience or person with 5 yrs related experience         |
| d.   | Architectural | Graduate Architect with 2 yrs experience or person with 5 yrs related experience                   |
| e.   | Submittals    | Submittal Clerk with 1 yr experience   |

#### 3.4.3.1 Proper CQC Staffing

The minimum requirements for the CQC staff will not necessarily assure an adequate staff to meet the CQC requirements at all times during construction. The actual strength of the CQC staff may vary during any specific work period to cover the needs of the work period. When necessary for a proper CQC organization, the Contractor will add additional staff at no cost to the Government. This listing of minimum staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with contract requirements. All CQC staff members shall be subject to acceptance by the Contracting Officer.

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#### 3.4.3.2 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

#### 3.4.3.3 Training

In addition to the above experience and education requirements the CQC System Manager or the principal member of the CQC staff shall attend a 16 hour training course on "Construction Quality Management." This course will be periodically offered by the Corps of Engineers and times, dates and location will be provided at the Pre-construction Conference.

### 3.5 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. The controls shall be adequate to cover all construction operations, including both on-site and off-site fabrication, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of control to be conducted by the CQC system manager for all definable features of work, as follows:

#### 3.5.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by the Government personnel until final acceptance of the work.
- b. A review of the contract plans.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. A check to assure that provisions have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawing or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

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- h. Discussion of procedures for constructing the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that phase of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. A discussion of the initial control phase.
- k. The Government shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.5.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of preliminary work to ensure that it is in compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with sample panels is appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC system manager and attached to the daily QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases. The initial phase should be repeated for each new crew to work on-site, or any time acceptable specified quality standards are not being met.
- g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

### 3.5.3 Follow-up Phase

Daily checks shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all



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deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

#### 3.5.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases may be conducted on the same definable features of work as determined by the Government if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff; in the on-site production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

### 3.6 TESTS

#### 3.6.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Laboratory must be currently listed by the Corps' Material Testing Center (MTC) as approved to perform intended tests prior to performing the work. The Contractor shall pay for initial inspection of selected laboratory if laboratory is not currently approved. Cost of inspection is currently \$6,500 (approximately) per laboratory for each site visit. The District will coordinate the inspection with the MTC, and all direct expenses will be deducted from the Contractor's next progress payment following the inspection. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, will be recorded on the Quality Control report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. Actual test reports may be submitted later, if approved by the Contracting Officer, with a reference to the test number and date taken. The test reports shall be signed by a registered professional engineer or a representative of the testing laboratory who is specifically authorized to certify test reports. The signature shall be an original, not a rubber stamp. The cover sheet for each test report shall be conspicuously stamped in large, red letters, "CONFORMS" OR "DOES NOT CONFORM" to the specification requirements, as applicable. An information copy of tests performed by an off-site or commercial test facility will be provided directly to the Contracting

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Officer. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.6.2 Testing Laboratories

#### 3.6.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM C 1077, ASTM D 3666, ASTM D 3740 and ASTM E 329.

#### 3.6.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$6,500.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

### 3.6.3 On-Site Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

### 3.6.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Unless otherwise directed by the Contracting Officer, samples of materials for test verification and acceptance testing by the Government shall be delivered to the Materials Testing Center, f.o.b., at the following address or to the destination(s) designated by the Contracting Officer:

U. S. Army Waterways Experiment Station  
Materials Testing Center  
3909 Halls Ferry Road  
Vicksburg, MS, 39180-6199

Coordination for each specific test, exact delivery location and dates will be made through the Area Office.

## 3.7 COMPLETION INSPECTION

### 3.7.1 Punch-Out Inspection

At the completion of all work or any increment thereof established by a completion time stated in the Special Contract Requirements entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC system manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved plans and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will

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be corrected. The CQC system manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Government. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates. Once this is accomplished, the Contractor shall notify the government that the facility is ready for the Government Pre-Final Inspection.

### 3.7.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government pre-final punch list may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so a final inspection with the customer can be scheduled. Any items noted on the pre-final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

### 3.7.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Post Directorate of Public Works user groups, and major commands may be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the pre-final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction".

### 3.8 DOCUMENTATION

The Contractor shall maintain current records of quality control operations, activities, and tests performed, including the work of subcontractors and suppliers. These records shall be on an acceptable form and shall include factual evidence that required quality control activities and/or tests have been performed, including but not limited to the following:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work

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performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.

e. Quantity of material received at the site with statement as to its acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Off-site surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

k. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within the first workday following the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC system manager. The report from the CQC system manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

### 3.9 SAMPLE FORMS

Sample forms are enclosed at the end of this section.

### 3.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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### 3.11 RESIDENT MANAGEMENT SYSTEM (RMS)

The Resident Management System (RMS) shall be implemented by the Contractor in accordance with Section 01 45 01.10 USACE QUALITY CONTROL SYSTEMS (QCS).

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PREPARATORY INSPECTION CHECKLIST

Contract No.:

Date:

Title:

Specs Section:

MAJOR DEFINABLE SEGMENT OF WORK:

A. PERSONNEL PRESENT:

| NAME | POSITION | COMPANY |
|------|----------|---------|
| 1.   |          |         |
| 2.   |          |         |
| 3.   |          |         |
| 4.   |          |         |
| 5.   |          |         |
| 6.   |          |         |
| 7.   |          |         |
| 8.   |          |         |
| 9.   |          |         |
| 10.  |          |         |

(List additional personnel on reverse side.)

B. TRANSMITTALS INVOLVED:

| CONTRACTOR OR NUMBER & ITEM<br>APPROVAL | CODE | GOVERNMENT |
|---|------|------------|
| 1.                                      |      |            |
| 2.                                      |      |            |
| 3.                                      |      |            |
| 4.                                      |      |            |
| 5.                                      |      |            |
| 6.                                      |      |            |

B-I. Have all items involved been approved?

Yes

No

B-II. What items have not been approved?

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| ITEM | STATUS |
|------|--------|
|------|--------|

1.

2.

3.

4.

5.

|                               |     |    |
|-------------------------------|-----|----|
| C. ARE ALL MATERIALS ON HAND? | Yes | No |
|-------------------------------|-----|----|

C-I. Are all materials on hand in accordance with approvals?

|     |    |
|-----|----|
| Yes | No |
|-----|----|

C-II. Items not on hand or not in accordance with transmittals:

1.

2.

3.

4.

D. TESTS REQUIRED IN ACCORDANCE WITH CONTRACT REQUIREMENTS:

| TEST | PARAGRAPH |
|------|-----------|
|------|-----------|

1.

2.

3.

E. ACCIDENT PREVENTION PREPLANNING - HAZARD CONTROL MEASURES:

E-I. Applicable Outlines (Attach Completed Copies):

1.

2.

3.

4.

5.

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E-II. Operational Equipment Checklists:

ATTACHED FOR:

1.

2.

3.

ON FILE FOR:

1.

2.

3.

Quality Control - Prime Contractor

Quality Control - Work Involved



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## INITIAL INSPECTION CHECKLIST

Contract No.:

Date:

Description and Location of Work Inspected:

Specs Section:

REFERENCE CONTRACT DRAWINGS:

A. PERSONNEL PRESENT:

|     | NAME | POSITION | COMPANY |
|-----|------|----------|---------|
| 1.  |      |          |         |
| 2.  |      |          |         |
| 3.  |      |          |         |
| 4.  |      |          |         |
| 5.  |      |          |         |
| 6.  |      |          |         |
| 7.  |      |          |         |
| 8.  |      |          |         |
| 9.  |      |          |         |
| 10. |      |          |         |

B. MATERIALS BEING USED ARE IN STRICT COMPLIANCE WITH THE CONTRACT PLANS AND SPECIFICATIONS.

Yes

No IF NOT, EXPLAIN:

C. PROCEDURES AND/OR WORK METHODS WITNESSED ARE IN STRICT COMPLIANCE WITH THE REQUIREMENTS OF THE CONTRACT SPECIFICATIONS.

Yes

No IF NOT, EXPLAIN:

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D. WORKMANSHIP IS ACCEPTABLE.

|     |    |   |
|-----|----|---|
| Yes | No | STATE AREAS WHERE IMPROVEMENT<br>IS NEEDED: |
|-----|----|---|

E. SAFETY VIOLATIONS AND CORRECTION ACTION TAKEN:

Quality Control Representative

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OPERATION AND MAINTENANCE FIELD INSTRUCTIONS

CONTRACT NO.

DESCRIPTION

LOCATION

DATE

Operation and maintenance instructions were conducted for (Type of  
Equipment)  
required by section , paragraph ,  
on . (Date)

The following personnel were present: (Signatures of Attendees)

Instructions were given by (Contractor's Representative)  
The personnel identified herein by their signatures certify that they have  
been instructed in the operation and maintenance of the above-mentioned  
equipment.

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PIPING SYSTEM TEST REPORT

STRUCTURE OR BUILDING

CONTRACT NO.

DESCRIPTION OF SYSTEM OR PART OF SYSTEM TESTED:

DESCRIPTION OF TEST:

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR CONTRACTOR:

NAME

TITLE

SIGNATURE

I HEREBY CERTIFY THAT THE ABOVE-DESCRIBED SYSTEM HAS BEEN TESTED AS  
INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE  
CONTRACT SPECIFICATIONS.

(SIGNATURE OF INSPECTOR)

(DATE)

REMARKS:

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CONTRACTOR'S INSPECTOR ROOFING CHECKLIST AND TEST REPORT

DATE:

WEATHER:

CONTRACT NO.:

All data required to be taken from labels on container.

1. Type of bitumen used with underlayment or insulation and area covered
2. Type of bitumen used with base sheet and area covered
3. Type of bitumen used for mopping 4 plies
4. Type of bitumen used for flood coat or surfacing gravel
5. Type and thickness of insulation or underlayment used
6. Type of base sheet used
7. Type of felt used
8. Source of surface gravel and condition, wet, dry, clean
9. Roofing sample(s), location and weight
10. Bitumen sample furnished to the Government, quantity and type
11. Bitumen temperature checks, type of asphalt, time taken, maximum temperature specified
12. Are brooms being used?                      Yes                      No.
13. Bituminous cement used, type and usage
14. Area covered

Contractor's Approved Authorized  
Representative

Quality Control Inspector

-- End of Section --

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## SECTION 01 45 01.10

### USACE QUALITY CONTROL SYSTEM (QCS) 01/08

#### PART 1 GENERAL

##### 1.1 Contract Administration

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor must use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data

##### 1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record will also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

##### 1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01.00 10 PROJECT SCHEDULE, Section 01 33 00 SUBMITTAL PROCEDURES, and Section 01 45 01.10 USACE QUALITY CONTROL SYSTEM (QCS), which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith will be included in the contract pricing for the work.

##### 1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor will be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government

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RMS Website as they become available.

### 1.3 SYSTEM REQUIREMENTS

The following is the minimum system configuration that the Contractor must have to run QCS:

#### QCS and QAS System

##### **Hardware**

IBM-compatible PC with 1000 MHz Pentium or higher processor  
256+ MB RAM for workstation / 512+ MB RAM for server  
1 GB hard drive disk space for sole use by the QCS system  
3-1/2 inch high-density floppy drive  
Compact Disk (CD) Reader 8x speed or higher  
SVGA or higher resolution monitor (1024x768, 256 colors)  
Mouse or other pointing device  
Windows compatible printer. (Laser printer must have 4 MB+ of RAM)  
Connection to the Internet, minimum 56k BPS

##### **Software**

MS Windows 2000 or higher  
QAS-Word Processing software: MS Word 2000 or newer  
Latest version of: Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher  
Electronic mail (E-mail) MAPI compatible  
Virus protection software that is regularly upgraded with all issued manufacturer's updates

### 1.4 RELATED INFORMATION

#### 1.4.1 QCS User Guide

After contract award, download instructions for the installation and use of QCS from the Government RMS Internet Website. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

#### 1.4.2 Contractor Quality Control (CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

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#### 1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by using the Government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

#### 1.6 DATABASE MAINTENANCE

Establish, maintain, and update data in the QCS database throughout the duration of the contract at the Contractor's site office. Submit data updates to the Government (e.g., daily reports, submittals, RFI's, schedule updates, payment requests, etc.) using the Government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, e-mail or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically includes current data on the following items:

##### 1.6.1 Administration

###### 1.6.1.1 Contractor Information

Contain within the database the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, deliver Contractor administrative data in electronic format.

###### 1.6.1.2 Subcontractor Information

Contain within the database the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Assign each subcontractor/trade a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, deliver subcontractor administrative data in electronic format.

###### 1.6.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters must be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

###### 1.6.1.4 Equipment

Contain within the Contractor's QCS database a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

###### 1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet,



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QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

#### 1.6.1.6 Request For Information (RFI)

Exchange all Requests For Information (RFI) using the Built-in RFI generator and tracker in QCS.

#### 1.6.2 Finances

##### 1.6.2.1 Pay Activity Data

Include within the QCS database a list of pay activities that the Contractor must develop in conjunction with the construction schedule. The sum of all pay activities must be equal to the total contract amount, including modifications. Group pay activities Contract Line Item Number (CLIN); the sum of the activities must equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

##### 1.6.2.2 Payment Requests

Prepare all progress payment requests using QCS. Complete the payment request worksheet, prompt payment certification, and payment invoice in QCS. Update the work completed under the contract, measured as percent or as specific quantities, at least monthly. After the update, generate a payment request report using QCS. Submit the payment request, prompt payment certification, and payment invoice with supporting data using the Government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, e-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which will govern in the event of discrepancy with the electronic version.

#### 1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements. Maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. Provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 44 00 CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

##### 1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS must be the Contractor's official report. Summarize data from any supplemental reports by the Contractor and consolidate onto the QCS-generated Daily CQC Report. Submit daily CQC Reports as required by Section 01 44 00 CONTRACTOR QUALITY CONTROL. Electronically submit reports to the Government within 24 hours after the date covered by the report. Also provide the Government a signed, printed copy of the daily CQC report.

##### 1.6.3.2 Deficiency Tracking.

Use QCS to track deficiencies. Deficiencies identified by the Contractor

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will be numerically tracked using QC punch list items. Maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. Regularly update the correction status of both QC and QA punch list items.

#### 1.6.3.3 QC Requirements

Develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. Update all data on these QC requirements as work progresses, and promptly provide this information to the Government via QCS.

#### 1.6.3.4 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

#### 1.6.3.5 Labor and Equipment Hours

Log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

#### 1.6.3.6 Accident/Safety Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. Regularly update the correction status of the safety comments. In addition, utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 300.

#### 1.6.3.7 Features of Work

Include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

#### 1.6.3.8 Hazard Analysis

Use QCS to develop a hazard analysis for each feature of work included in the CQC Plan. Address any hazards, or potential hazards, that may be associated with the work.

#### 1.6.4 Submittal Management

The Government will provide the initial submittal register in electronic format. Thereafter, maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. Use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update must be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

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#### 1.6.5 Schedule

Develop a construction schedule consisting of pay activities, in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE. Input and maintain in the QCS database this schedule either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01 32 01.00 10 PROJECT SCHEDULE). Include with each pay request the updated schedule.

#### 1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from RMS, and schedule data using SDEF.

#### 1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

#### 1.8 DATA SUBMISSION VIA CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the Government's SFTP repository built into QCS export function. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of CD-ROM for data transfer. Export data onto CDs using the QCS built-in export function. If used, submit CD-ROMs in accordance with the following:

##### 1.8.1 File Medium

Submit in English required data on CD-ROM conforming to industry standards used in the United States.

##### 1.8.2 CD-ROM Labels

Affix a permanent exterior label to each CD-ROM submitted. Indicate on the label in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

##### 1.8.3 File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software must not be altered.

#### 1.9 MONTHLY COORDINATION MEETING

Update the QCS database each workday. At least monthly, generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, meet with the Government representative to review the planned progress payment data submission for errors and omissions.

Make all required corrections prior to Government acceptance of the export

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file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

#### 1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification.

#### PART 2 PRODUCTS

Not Used

#### PART 3 EXECUTION

Not Used

-- End of Section --



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SECTION 01 45 35

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R (2005; Errata 2005) Building Code Requirements for Structural Concrete and Commentary

ACI 530/530.1 (2002) Building Code Requirements for Masonry Structures and Specifications for Masonry Structures and Commentaries

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341 (2005) Seismic Provisions for Structural Steel Buildings

AISC 350 (2005) Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A 615/A 615M (2007) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 302 (Feb 1998) NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Special Inspector; G

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Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Assurance Plan; G

A copy of the Quality Assurance Plan covered by a certificate indicating that the plan meets the content specified in this section.

### 1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

### 1.4 QUALITY ASSURANCE PLAN

A quality assurance plan shall be developed containing the following:

- a. A list of all items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.
- b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.
- c. The content, distribution, and frequency of special inspection reports.
- d. The content, distribution, and frequency of testing reports.
- e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

### 1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

#### 1.5.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Continuous special inspection shall be performed where

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specified for items as shown on the drawings.

#### 1.5.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Periodic special inspection shall be performed where specified for items as shown on the drawings.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

#### 3.1 PERFORMANCE OF INSPECTIONS

Special Inspections shall be performed for the following where designated on the drawings:

##### 3.1.1 Reinforcing Steel

a. Periodic special inspection during and upon completion of the placement of reinforcing steel in foundations.

##### 3.1.2 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete in foundations and elevated slabs.

##### 3.1.3 Structural Masonry

a. Periodic special inspection during the preparation of mortar, the laying of masonry units, and placement of reinforcement and prior to placement of grout.

b. Continuous special inspection during the welding of reinforcement, grouting, consolidation and reconsolidation.

##### 3.1.4 Structural Steel

a. Continuous special inspection for all structural welding, except that periodic special inspection is permitted for single-pass or resistance welds provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work and all welds are inspected for compliance with the approved construction documents at the completion of welding.

##### 3.1.5 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:



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a. Periodic special inspection during the erection and fastening of exterior cladding interior nonloadbearing partition walls.

b. Periodic special inspection during the anchorage of access floors suspended ceilings.

### 3.1.6 Mechanical and Electrical Components

Special inspection of the mechanical and electrical components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.

b. Periodic special inspection during the installation of anchorage of all other electrical equipment.

c. Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.

d. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

### 3.2 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

a. Reinforcing and Prestressing Steel: Special testing of reinforcing and prestressing steel shall be as follows:

(1) Examine certified mill test reports for each shipment of reinforcing steel used in reinforced concrete reinforced masonry shear walls. The special inspector shall determine conformance with the construction documents.

(2) Examine the reports for chemical tests, done in accordance with Sec. 3.5.2 of ACI 318/318R, which were performed to determine the weldability of ASTM A 615/A 615M reinforcing steel.

b. Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318/318R and comply with all acceptance provisions contained therein.

c. Structural Masonry: Verify that all quality assurance testing of structural masonry along with all material components is in accordance with the requirements of ACI 530/530.1 and complies with all acceptance provisions contained therein.

d. Structural Steel:

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(1) Verify that all quality assurance testing needed to confirm required material properties has been done in accordance with applicable provisions in AISC 341 and AISC 350 and that the test results comply with all acceptance provisions contained therein.

e. Seismically Isolated Structures: Verify that the required system and component tests for seismically isolated structures have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.

f. Energy Dissipation Systems: Verify that the required system and component tests for seismic energy dissipation systems have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.

### 3.3 REPORTING AND COMPLIANCE PROCEDURES

- a. On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report shall be signed by the Contractor.
- b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors. The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

-- End of Section --



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SECTION 01 50 02.00 10

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00.00 10 SUBMITTAL PROCEDURES:

SD-01 Pre-construction Submittals

Site Plan; G, RE

Drawing(s) shall show the layout of the proposed temporary fencing.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1994) (FAR 52.236-14)

1.2.1 Availability

The Government will make available to the Contractor, from existing outlets and supplies, all reasonably required amounts of utilities as specified in the Contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Use

The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

1.3 PAYMENT FOR UTILITY SERVICES (APR 1984)

Water, gas, and electricity are available from Government owned and operated systems and will be furnished without charge to the Contractor.

1.4 PAYMENT FOR UTILITY SERVICES (APR 1984)

Water, gas, and electricity are available from Government-owned and -operated systems and will be charged to the Contractor at rates as provided in the paragraph "Availability and Use of Utility Services."

To obtain current utility rates and information, contact the following:

- a. Water: American Water Services, Ronnie Graves, 580-248-3046, for information on water and sanitary sewer distribution system, hookups, system expansion; Al Shields, Ft. Sill DPW, 580-442-3608, for water

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rates.

- b. Oklahoma Natural Gas, Robert Simms, 580-353-1985.
- c. Electricity and Landfill, Andrew Bennett, 580-581-5230
- d. Government Communication Lines, Kathy Banks, Director of Information Management, Ft. Sill, 580-442-3617.
- e. Southwestern Bell, Rick Hawkins, 580-581-5230.

#### 1.5 UTILITY SERVICES (APR 1984)

No utilities will be furnished by the Government.

#### 1.6 SECURITY REQUIREMENTS FOR CORPS OF ENGINEERS' UNCLASSIFIED CONTRACTS

The Contractor shall be required to comply with requirements of Clause 52.0000-4515, SECURITY CONTRACT LANGUAGE FOR ALL CORPS' OF ENGINEERS' UNCLASSIFIED CONTRACTS (APR 2004), paragraphs A. AUTOMATED INFORMATION SYSTEM (AIS) EFFORT and C. FOREIGN NATIONALS. [The work for this contract includes work on or around powerhouses, switchyards, locks/dams, or other restrictive/sensitive areas, therefore, paragraph B. NATIONAL INFRASTRUCTURES EFFORT, of Clause 52.0000-4515 shall also apply.] Refer to Section 00 21 00 for clause.

#### 1.7 IDENTIFICATION OF EMPLOYEES (APR 1985)

The Contractor shall furnish identification to each employee as directed by the Contracting Officer. Upon the release of any employee, the identification shall be delivered to the Contracting Officer for cancellation.

#### 1.8 ISSUANCE OF IDENTIFICATION CREDENTIALS TO CONTRACTOR PERSONNEL AT TINKER AFB (SWTCD)

Temporary personnel identification credentials are issued by Tinker AFB for a period of 5 calendar days. Temporary credentials may be renewed one time only for an additional 5 calendar days. The Contractor shall apply for and obtain long term identification credentials for his employees prior to the expiration of the 10 day maximum temporary pass period. Additional information for obtaining temporary and long term credentials may be obtained from the Contracting Officer.

#### 1.9 MECHANICAL AND ELECTRICAL ROOM CONTROLLED ACCESS

The Contractor shall be provided keys to mechanical rooms when the project results in renovation of a complete facility or replacement of the equipment in the mechanical rooms. The mechanical room lock shall be re-keyed with a construction core, and the Contractor shall have exclusive control of all equipment located within the mechanical room. The Fire Department and Base Civil Engineering shall have a key to access the mechanical room only in case of an emergency. The Contractor shall accept full liability for any damages caused by utility outages to the occupied facility.

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#### 1.10 HAUL ROADS (CESWT-CT)

##### 1.10.1 One-Way Roads

Whenever practical, one-way haul roads shall be used on this contract. One-way haul roads for off-the-road equipment (e.g., belly dumps, scrapers, and off-the-road trucks) shall have a minimum usable width of 25 feet. One-way haul roads for over-the-road haulage equipment only (e.g., dump trucks, etc.) may be reduced to a usable width of 15 feet. When the Contracting Officer determines that it is impractical to obtain the required width for one-way haul roads (e.g., a road on top of a levee), a usable width of not less than 10 feet may be approved by the Contracting Officer, provided a positive means of traffic control is implemented. Such positive means shall be signs, signals, and/or signalman and an effective means of speed control.

##### 1.10.2 Two-Way Roads

Two-way haul roads for off-the-road haulage equipment shall have a usable width of 60 feet. Two-way haul roads for over-the-road haulage equipment only may be reduced to a usable width of 30 feet.

##### 1.10.3 Maintenance

Haul roads shall be graded and otherwise maintained to keep the surface free from potholes, ruts, and similar conditions that could result in unsafe operation. [Haul routes on Tinker AFB, OK, shall be kept clean of any construction-related debris. The Contractor shall clean off dirt from paved surfaces, not allowing dirt to pack on roads or to create a traffic nuisance. It shall be the Contractor's responsibility to ensure proper loading of all vehicles used for transport of materials and construction debris. Any spillage en route on the Base shall be promptly removed and disposed of off-Base in accordance with applicable local, State, and Federal laws and regulations.]

##### 1.10.4 Design

Grades and curves shall allow a minimum sight distance of 200 feet for one-way roads and 300 feet for two-way roads. Sight distance is defined as the centerline distance an equipment operator (4.5 feet above the road surface) can see an object 4.5 feet above the road surface. When conditions make it impractical to obtain the required sight distance (e.g., ramps over levees), a positive means of traffic control shall be implemented.

##### 1.10.5 Dust Control

Dust abatement shall permit observation of objects on the roadway at a minimum distance of 300 feet.

##### 1.10.6 Markings

Haul roads shall have the edges of the usable portion marked with posts at intervals of 50 feet on curves and 200 feet maximum elsewhere. Such markers shall extend 6 feet above the road surface and, for nighttime haulage, be provided with reflectors in both directions.

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#### 1.10.7 Debris and Spillage - Vacuum Type Sweeper Requirement

The Contractor shall provide a working vacuum-type street/parking lot sweeper when working on or near aircraft traffic areas. The sweeper shall be on site prior to commencing work on the project and shall remain on site at all times any work is performed. The sweeper shall be used to clean all areas in and adjacent to the work areas that are open to vehicular or aircraft traffic. The Contracting Officer or his representative will determine cleanliness of aircraft traffic areas.

#### 1.11 MOWING

Grass and weedy vegetation within the areas utilized by the Contractor, including work areas, administrative areas, and storage areas, shall be kept mowed to control vegetative growth. Vegetation shall be mowed to a height of 3 inches when it reaches a height of 6 inches. Mowing shall be done with a rotary mower. Mowing shall be done during periods and in such a manner that the soil and grass will not be damaged. Areas adjacent to trees, shrubs, fences, buildings, etc. shall be hand trimmed. The Government may, after notice to the Contractor and at the discretion of the Contracting Officer, mow the Contractor's areas at any time the vegetation height exceeds 6 inches and all costs incurred by the Government for performing such work will be deducted from the contract.

#### 1.12 PLANT LAYOUT DRAWINGS (CESWT-CT)

Drawings, in triplicate, showing the layout of the plant the Contractor proposes to use on the work shall be submitted by the Contractor for review by the Contracting Officer. The drawings shall show the locations of the principal components of the construction plant; offices; shop and storage buildings; housing facilities, if any; and storage areas and yards which Contractor proposes to construct at the site of the work and elsewhere. The Contractor shall also furnish for review by the Contracting Officer drawings in triplicate, showing the general features of his aggregate processing plant; aggregate transporting, storage and reclaiming facilities; aggregate rinsing and dewatering plant, if required; coarse aggregate rescreening plant, if required; concrete batching and mixing plant; concrete conveying and placing plant, and when precooling of concrete is required, the cooling plant. The drawing shall appropriately show the capacity of each major feature of the plan including the rated capacity of the aggregate production plant in tons per hour of fine and coarse aggregates; rated capacity of the aggregate transporting, storage and reclaiming facilities; volume of aggregate storage; capacity of cement and pozzolan storage; rated capacity of the concrete batching and mixing plant in cubic yards per hour; rated capacity of the concrete transporting and placing plant in cubic yards per hour; and when used, rated capacity of plant for precooling of concrete. Drawings in triplicate showing any changes in plant made during design and erection or after the plant is in operation shall be submitted to the Contracting Officer for review. Two sets of the drawings will be retained by the Contracting Officer and one set will be returned to the Contractor with comments.

#### 1.13 STAGING AREA PREPARATION (REQUEST BY DE, JUL 91)

The Contractor's staging area or areas shall be located within the boundaries of the project parking lots shown. The staging area(s) shall be prepared by the Contractor to the limits as [required] [shown] for the Contractor's temporary field office facilities, material storage, parking, [Government offices], and other necessary staging activities. The

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Contractor shall prepare the staging area and the driveway access by grading and constructing in accordance with the plans and specifications. The parking area and drives may be constructed to pavement completion or to partial completion as desired but shall be not less than the construction of base course. The Contractor shall be responsible for the maintenance of all completed or partially completed construction and shall repair any damage prior to acceptance of the project.

#### 1.14 CONSTRUCTION MATERIAL STORAGE

Contractors shall store construction materials only in designated staging areas or areas designated by the Contracting Officer. Grass and weedy vegetation shall be mowed during the duration of the contract in accordance with paragraph entitled MOWING. Storage areas located along the Distinguished Visitor Route shall be screened to a height of 6 feet above grade and supported by a chainlink fence system. Fence posts shall be set in concrete bases. The storage area gates shall also be screened. Screening material shall provide 80 percent concealment, minimum, and shall be installed in a permanent manner. No roofing or other material shall be stored on roofs on inhabited buildings unless prior written authority has been obtained from the Contracting Officer.

Distinguished Visitor Route includes: Air Depot from the Main Gate to Arnold Street; Arnold Street from Mitchell Avenue to "A" Avenue; Mitchell Avenue from Arnold Street to Buildings 5603, 5604, 5605, 5606; "A" Avenue from Building 240 to Perimeter Road; Perimeter Road from "A" Avenue to Industrial Blvd.; Industrial Blvd. from Perimeter Road to Staff Drive; and Staff Drive from Industrial Blvd. to the Main Entrance of Building 3001.

#### 1.15 TEMPORARY CONSTRUCTION FENCING

The Contractor shall provide temporary construction fencing (or a substitute acceptable to the Contracting Officer and delineated in the Accident Prevention Plan) on all projects located in areas of active use by members of the public, close to family housing areas and/or school facilities. Temporary fencing shall be removed at the end of construction and the areas affected by the fencing shall be returned to the original state prior to construction.

#### 1.16 WARNING SIGNS

The Contractor shall place warning signs at the construction area perimeter designating the presence of construction hazards and requiring unauthorized persons to keep out. For exterior construction, signs must be placed on all sides of the project with at least one sign every 300 feet. All points of entry shall have signs designating the construction site as a hardhat area. For interior construction projects, signs shall be placed only at points of entry. Warning signs shall be removed by the Contractor at the end of construction.

#### 1.17 TEMPORARY CONSTRUCTION FENCING AND WINDSCREENING

The contractor shall provide temporary construction fencing and windscreening on all projects unless directed otherwise by the Contracting Officer. Temporary fencing shall consist of 6-foot high chain link fencing and windscreening. Chain-link fencing shall have a top rail and schedule 40 (minimum) posts at 10 foot maximum spacing. Contractor shall install temporary fencing with set-back at 45 degree angles at fence corners that terminate at road intersections and entrances to site to provide adequate



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site distance for vehicle safety. Contractor shall submit a site plan with proposed fencing layout for the Contracting Officer's approval. Temporary fencing and windscreening shall be removed at the end of the construction, and the areas affected by the fencing shall be returned to the original state prior to construction.

#### 1.17.1 Windscreening

Windscreening shall consist of polyethylene closed or knit mesh fabric that provides between 94 to 100 percent visual privacy. Windscreen fabric shall be finished on all sides by hemming or binding and shall have built-in grommets. Windscreening shall cover the full-height and length of the temporary fencing including gates and shall be attached to the fencing as recommended by the manufacturer. Color shall be dark brown. Windscreening fabric that becomes torn or worn during the construction period shall be replaced by the Contractor at no additional cost to the Government.

Windscreening is available from National Construction Rentals, Dallas, TX, (214)634-2091. Supplier shown is not meant to limit the contractor from using other manufacturers/suppliers of windscreening materials that meet the requirements shown above.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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## SECTION 01 57 20.00 02

### ENVIRONMENTAL PROTECTION

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPAPUB (2003) NPDES (National Pollution Discharge Elimination System) General Permits for Storm Water Discharges from Construction Sites

##### 1.2 DEFINITIONS

For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual aesthetics, noise, solid waste, radiant energy and radioactive materials, as well as other pollutants.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00.00 10 SUBMITTAL PROCEDURES:

##### SD-01 Preconstruction Submittals

Environmental Protection Plan; G, RE.

The environmental protection plan shall address all items in the paragraph ENVIRONMENTAL PROTECTION REQUIREMENTS and shall be submitted with the Quality control Plan as described in Section 01 45 01.00 10.

Storm Water Pollution Prevention Plan (SWP3); G, RE.

The Storm Water Pollution Prevention Plan (SWP3) shall contain all the information required by the Oklahoma Department of Environmental Quality (ODEQ) General Permit OKR10 for storm water discharges from construction activities within the State of Oklahoma. A copy of the OKR10 permit may be found at the following web page:

[http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10\\_final\\_permit\\_13\\_sep\\_2002.pdf](http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10_final_permit_13_sep_2002.pdf)

In accordance with federal regulations and Oklahoma Department of Environmental Quality (ODEQ) General Permit for Storm Water Discharges from

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Construction Activities GP-005A, Contractor shall submit a detailed, site-specific plan to include Best Management Practices (BMPs) and control measures taken by Contractor during construction activities to control pollutants in storm water discharges. This plan shall be developed for construction projects of all sizes and submitted with Notice of Intent (NOI).

The SWP3 shall address all items in the paragraph STORM WATER POLLUTION PREVENTION PLAN (SWP3). The plan shall be submitted and approved prior to the beginning of construction. The Pollution Prevention Plan (SWP3) shall contain all the information required by the Texas Commission on Environmental Quality TPDES General Permit NO. TXR150000 for storm water discharges from construction activities within the State of Texas.

Waste Management Plan; G, RE.

The waste management plan shall address the waste stream, estimated quantities of waste, describe and tentatively classify the broad waste types anticipated such as; hazardous waste (with an EPA waste code); solid waste; medical waste; radioactive waste; mixed hazardous/radioactive waste; and other special waste. The rationale for assignment of waste to these broad waste categories shall be provided.

The water management plan shall address the waste stream, estimated quantities of waste, describe and tentatively classify the broad waste types as follows:

- a. Special wastes such as hazardous waste, medical waste, universal waste, radioactive waste, mixed hazardous/radioactive waste; and other special waste;
- b. Wastes including trash, garbage, cardboard, packing and crating, rubble, concrete, asphalt, metals, lumber, salvageable, recyclable, scrap, and others.

Spray Painting Plan; G, RE.

Submit a detailed plan to include resultant cost savings and procedures indicating methods of isolating contract area from other areas of building, when applicable.

Restoration Plan; G, RE.

Submit a restoration plan showing how trees, shrubs, grass areas, flower gardens, etc., scarred or damaged by the Contractor's equipment or operations, shall be restored to the original condition.

Notice of Intent (ODEQ Form 640-571); G, RE

Submit two (2) copies of a completed Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activities for coverage for all construction, demolition, or excavation projects. This form can be obtained from the Oklahoma Department of Environmental Quality at their web site, <http://www.deq.state.ok.us>. The Contractor shall submit the unsigned NOI forms to the Contracting Officer for submission to Fort Sill environmental personnel.

Notice of Termination (NOT) (ODEQ Form 640-572); G, RE

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Submit two (2) copies of the completed form to terminate coverage for Storm Water Discharges from Construction Activities. Form shall be submitted when final stabilization of construction site has been achieved. Final stabilization means all soil disturbing activities have been completed and a uniform vegetative with a density of 70 percent of native background cover has been established. This form can be obtained from the Oklahoma Department of Environmental Quality at their web site, <http://www.deq.state.ok.us>. The Contractor shall submit the NOT forms to the Contracting Officer for submission to Fort Sill environmental personnel.

INSERT INFORMATION FOR KANSAS

SD-07 Certificates

Maintenance of Pollution Control Training Certification

Submit a copy of all training materials used in training sessions for maintenance of pollution control along with an attendance sheet for each session.

#### 1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including but not limited to water, air, and noise pollution.

##### 1.4.1 Environmental Protection Plan

Within 15 days after receipt of Notice of Award of the contract and at least 7 days prior to the Preconstruction Conference, the Contractor shall submit in writing, with drawings, an Environmental Protection Plan and meet with representatives of the Contracting Officer to develop mutual understanding relative to compliance with this provision and administration of the environmental protection program. Approval of the Contractor's plan will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and other environmental protection measures. The Government reserves the right to make changes in his environmental protection plan and operations as necessary to maintain satisfactory environmental protection performance. The environmental protection plan shall include but not be limited to the following:

##### 1.4.1.1 Laws, Regulations, and Permits

The Contractor shall prepare a list of Federal, State and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations and permits.

##### 1.4.1.2 Notice of Intent (NOI)

If required, the Contractor shall submit two copies of a completed Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activities for coverage under the Base-wide permit as required in paragraph

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entitled SUBMITTALS contained in this section.

The Contractor is responsible for submitting the NOI as soon as possible after contract award. Failure to obtain there permit in a timely manner will not be grounds for a contract extension.

If required, the Contractor shall submit two copies of a completed Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activities to the Post Environmental Office as required in paragraph entitled SUBMITTALS contained in this section. The Post will submit the NOI to the State; the State will bill the Contractor for the fee. The Contractor is responsible for all payment of fees.

The Contractor is responsible for submitting the NOI as soon as possible after contract award. Failure to obtain there permit in a timely manner will not be grounds for a contract extension.

If required, the Contractor shall submit two copies of a completed Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activities to the State environmental agency as required in paragraph entitled SUBMITTALS contained in this section. The Contractor is responsible for all payment of fees.

The Contractor is responsible for submitting the NOI as soon as possible after contract award. Failure to obtain there permit in a timely manner will not be grounds for a contract extension.

#### 1.4.1.3 Protection of Features

The Contractor shall determine methods for the protection of features to be preserved within authorized work areas. The Contractor shall prepare a listing of methods to protect resources needing protection, i.e., trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archaeological and cultural resources.

#### 1.4.1.4 Procedures

The Contractor shall implement procedures to provide the required environmental protection and to comply with the applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes or failure to follow the procedures set out in accordance with the environmental protection plan.

#### 1.4.1.5 Permit or License

The Contractor shall obtain all needed permits or licenses for disposal of solid, liquid, chemical, and other waste generated as a result of this contract.

#### 1.4.1.6 Drawings

The Contractor shall include drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, stockpiles of earth materials, and disposal areas for excess earth material and unsatisfactory earth materials.

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#### 1.4.1.7 Environmental Monitoring Plans

The Contractor shall include environmental monitoring plans for the job site which incorporate land, water, air and noise monitoring.

#### 1.4.1.8 Traffic Control Plan

The Contractor shall include a traffic control plan for the job site.

#### 1.4.1.9 Surface and Ground Water

The Contractor shall establish methods of protecting surface and ground water during construction activities.

#### 1.4.1.10 Work Area Plan

The Contractor shall include a work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. The plan shall include measures for marking the limits of use areas.

#### 1.4.1.11 Plan of Borrow Area(s)

The Contractor shall include a plan of borrow area(s) for the job site.

#### 1.4.1.12 Method of Marking Clearing Limits

The Contractor shall include the method of marking and maintaining markings for limits of clearing.

#### 1.4.1.13 Method of Controlling Equipment

The Contractor shall include a plan of the method for controlling equipment maneuvering to avoid environmental damage.

#### 1.4.1.14 Training of Contractor's Personnel

The Contractor shall include a plan for training and control of his personnel for environmental damage.

#### 1.4.1.15 Prevention and Control of Spillage

The Contractor shall include a plan for prevention and control of damaging spillages.

#### 1.4.1.16 Layout of Work Areas and Other Areas

The Contractor shall include a plan of his method for layout of work areas, plant sites, haul roads, and borrow and waste areas.

#### 1.4.1.17 Method and Location of Waste and Debris Disposal

The Contractor shall include the location for disposal of waste and debris.

#### 1.4.1.18 Preplanning

Meetings of the Contractor with Contracting Officer or his authorized representative as specified in the paragraph MEETINGS, for the purpose of preplanning prevention of environmental damage.

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#### 1.4.1.19 Proposed Schedule for Training of Contractor Personnel

The Contractor shall include a schedule of proposed meetings to be attended by all Contractor personnel for the purpose of training for environmental protection with a Contracting Officer's representative present at appropriate intervals. Sufficient length of time to accomplish the purpose shall be included.

#### 1.4.1.20 Method of Training

The Contractor shall include a proposed method of training all new employees in environmental protection before they commence working project.

#### 1.4.1.21 Material Storage

Contractor shall provide a list sorting and identifying by chemical compatibility those materials to be used for the project. This information will be included in the EPP (Environmental Protection Plan) and will be updated periodically to insure all materials are included. It will be used to insure that incompatible chemicals are not stored together.

#### 1.4.1.22 Material Safety Data Sheets (MSDS)

MSDS forms shall be on file prior to use of listed chemicals.

### 1.5 STORM WATER POLLUTION PREVENTION PLANS (SWPPP OR SWP3)

The Contractor shall prepare a Storm Water Pollution Prevention Plan for the construction activity. [The Contractor is required to comply with the requirements outlined in the Oklahoma Department of Environmental Quality (ODEQ) General Permit for Storm Water Discharges from Construction Activities.] [This plan shall be in accordance with Texas Commission on Environmental Quality TPDES General Permit NO. TXR150000, issued on 05 March 2003, or the most recent Texas general permit issued pursuant to Section 26.040 of the Texas Water Code and Section 402 of the Clean Water Act.] Adequate Best Management Practices (BMPs) and appropriate control measures shall be included in the SWPPP to prevent construction dirt, chemicals, and/or debris from becoming a pollutant source to storm water discharges and to retain sediment on site. Such measures include but are not limited to silt fences, hay bails, earth dikes, sediment traps, storm drain inlet protection and temporary/permanent sediment basins.

Stabilization practices shall also be included in the SWPPP and implemented to preserve existing vegetation and to stabilize those portions of the construction site that were disturbed.

This plan shall be in accordance with EPAPUB NPDES General Permits for Storm Water Discharges from Construction Sites. [The plan shall be in accordance with ODEQ General Permit for Construction, General Permit OKR10 for Storm Water Discharge from Construction Activities within the State of Oklahoma.] The plan shall identify potential sources of pollution resulting from storm water discharge from the project site(s) and present methods for reducing or eliminating such discharge.

The Contracting Officer and the Contractor shall review the SWP3 to determine the adequacy of the plan. The SWP3 may be modified to insure that all current measures to prevent offsite migration of pollutants, including soils, are included in the plan. Contractor shall be required to

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amend the SWPPP as necessary, including when there is a change in the project's design, operation, or maintenance and when BMPs/control measures are ineffective in minimizing pollution.

No work that would disturb the natural vegetation shall be performed prior to the submission and approval of the SWP3 and receipt of the permit requested by the Notice of Intent unless approved by the Contracting Officer.

For all construction sites with a trailer or office, the Contractor shall post the a brief description of the project, point of contact, and the location of the SWP3. Contractors without an on-site trailer shall maintain the information in an easily accessible location.

#### 1.5.1 Contents of the Storm Water Pollution Prevention Plan (SWP3)

The SWP3 shall include the following items as a minimum. [It is the responsibility of the contractor to ensure the latest version of the General Permit OKR10 requirements are utilized when developing the SWP3.] [It is the responsibility of the contractor to ensure the latest version of the General Permit TXR150000 requirements are utilized when developing the SWP3.]

##### 1.5.1.1 Site Description

The SWP3 shall provide a description of potential pollutant sources and other information as indicated below:

- a. A description of the nature of the construction activity;
- b. A description of the intended sequence of major activities that disturb soils for major portions of the site (e.g., grubbing, excavation, grading, utilities and infrastructure installation);
- c. Estimates of the total area of the site and the total area of the site that is expected to be disturbed by excavation, grading, or other activities including off-site borrow and fill areas;
- d. An estimate of the runoff coefficient of the site for both the pre-construction and post-construction conditions and data describing the soil or the quality of any discharge from the site;
- e. A general location map (e.g., USGS quadrangle map, a portion of a city or county map) with enough detail to identify the location of the construction site and the receiving waters within one mile of the site and a site map indicating the following: drainage patterns and approximate slopes anticipated after major grading activities; areas of soil disturbance; areas that will not be disturbed; locations of major structural and nonstructural controls identified in the SWP3; locations where stabilization practices are expected to occur; locations of off-site material, waste, borrow or equipment storage areas; surface waters (including wetlands); and locations where storm water discharges to a surface water;
- f. Location and description of any discharge associated with industrial activity other than construction, including storm water discharges from dedicated asphalt plants and dedicated concrete plants, that is covered by the General Permit OKR10;



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g. The name of the receiving water(s) and the areal extent and description of wetlands or other special aquatic sites (as defined by 40 CFR 230.3(q-1)) at or near the site that will be disturbed or that will receive discharges from disturbed areas of the project;

h. A copy of the permit requirements (attaching a copy of the General Permit OKR10 is acceptable);

i. Information on whether listed endangered or threatened species, or critical habitat, are found in proximity to the construction activity and whether such species may be affected by the applicant's storm water discharges or storm water discharge-related activities; and

j. Information on whether storm water discharges or storm water discharge-related activities would have an affect on a property that is protected by Federal, State or local historic preservation laws along with any written agreements reached with the State services to mitigate those effects.

#### 1.5.1.2 Controls

The SWP3 shall include a description of appropriate control measures (i.e., Best Management Practices (BMP)) that will be implemented as part of the construction activity to control pollutants in storm water discharges. The SWP3 must clearly describe for each major activity identified in Part IV. E. 1. b listed in the General Permit OKR10: appropriate control measures and the general timing (or sequence) during the construction process that the measures will be implemented; and which permittee is responsible for implementation (e.g., perimeter controls for one portion of the site will be installed by Contractor A after the clearing and grubbing necessary for installation of the pollution prevention measure, but before the clearing and grubbing for the remaining portions of the site; and perimeter controls will be actively maintained by Contractor B until final stabilization of those portions of the site up-gradient of the perimeter control; and temporary perimeter controls will be removed by the permittee after final stabilization). The description and implementation of control measures shall address the following minimum components.

##### a. Erosion and Sediment Controls.

###### (1) Short and Long Term Goals and Criteria.

(a) The construction-phase erosion and sediment controls shall be designed to retain sediment on site to the extent practicable.

(b) All control measures must be properly selected, installed, and maintained in accordance with the manufacturer's specifications and good engineering practices. If periodic inspections or other information indicates a control has been used inappropriately, or incorrectly, the permittee must replace or modify the control for site situations.

(c) If sediment escapes the construction site, off-site accumulations of sediment must be removed at a frequency sufficient to minimize offsite impact (e.g., fugitive sediment in street could be washed into storm sewers by the next rain and/or pose a safety hazard to users of public streets).

(d) Sediment must be removed from sediment traps or

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sedimentation ponds when design capacity has been reduced by 50%.

(e) Litter, construction debris, and construction chemicals exposed to storm water shall be prevented from becoming a pollutant source for storm water discharges (e.g., screening outfalls, picked up daily).

(f) Offsite material storage areas (also including overburden and stockpiles of dirt, borrow areas, etc.) used solely by the permitted project are considered a part of the project and shall be addressed in the SWP3.

(2) Stabilization Practices. The SWP3 must include a description of interim and permanent stabilization practices for the site, including a schedule of when the practices will be implemented. Site plans should ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized. Stabilization practices may include but are not limited to: establishment of temporary vegetation, establishment of permanent vegetation, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures. Use of impervious surfaces for stabilization should be avoided.

The following records shall be maintained and attached to the SWP3: the dates when major grading activities occur; the dates when construction activities temporarily or permanently cease on a portion of the site; and the dates when stabilization measures are initiated.

Except as provided in (a), (b), and (c) below, stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

(a) Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently ceased is precluded by adverse climatological conditions (i.e. snow, ice, heavy rains, or drought) stabilization measures shall be initiated as soon as practicable.

(b) Where construction activity on a portion of the site is temporarily ceased, and earth disturbing activities will be resumed within 21 days, temporary stabilization measures do not have to be initiated on that portion of site.

(c) In arid areas (areas with an average annual rainfall of 0 to 10 inches), semiarid areas (areas with an average annual rainfall of 10 to 20 inches), and areas experiencing droughts where the initiation of stabilization measures by the 14th day after construction activity has temporarily or permanently ceased is precluded by seasonably arid conditions, stabilization measures shall be initiated as soon as practicable.

(3) Structural Practices. The SWP3 must include a description of structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants

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from exposed areas of the site to the degree attainable. Structural practices may include but are not limited to: silt fences, earth dikes, drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions, and temporary or permanent sediment basins. Placement of structural practices in floodplains should be avoided to the degree attainable. The installation of these devices may be subject to Section 404 of the Clean Water Act (CWA).

(a) For common drainage locations that serve an area with ten (10) or more acres disturbed at one time, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 2 year, 24 hour storm from each disturbed acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. Where no such calculation has been performed, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. When computing the number of acres draining into a common location it is not necessary to include flows from offsite areas and flows from onsite areas that are either undisturbed or have undergone final stabilization where such flows are diverted around both the disturbed area and the sediment basin.

In determining whether installing a sediment basin is attainable, the permittee may consider factors such as site soils, slope, available area on site, etc. In any event, the permittee must consider public safety, especially as it relates to children, as a design factor for the sediment basin and alternative sediment controls shall be used where site limitations would preclude a safe design. For drainage locations that serve ten (10) or more disturbed acres at one time and where a temporary sediment basin or equivalent controls is not attainable, smaller sediment basins and/or sediment traps should be used. Where neither the sediment basin nor equivalent controls are attainable due to site limitations, silt fences, vegetative buffer strips, or equivalent sediment controls are required for all down slope boundaries of the construction area and for those side slope boundaries deemed appropriate as dictated by individual site conditions. The Oklahoma Department of Environmental Quality (ODEQ) encourages the use of a combination of sediment and erosion control measures in order to achieve maximum pollutant removal.

(b) For drainage locations serving less than 10 acres, smaller sediment basins and/or sediment traps should be used. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required for all down slope boundaries (and for those side slope boundaries deemed appropriate as dictated by individual site conditions) of the construction area unless a sediment basin providing storage for a calculated volume of runoff from a 2 year, 24 hour storm or 3,600 cubic feet of storage per acre drained is provided. The Oklahoma Department of Environmental Quality (ODEQ) encourages the use of a combination of sediment and erosion control measures in order to achieve maximum pollutant removal.

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b. Storm Water Management.

A description of measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed must be included in the SWP3. Structural measures should be placed on upland soils to the degree attainable. The installation of these devices may also require a separate permit under Section 404 of the CWA.

Permittees are only responsible for the installation and maintenance of storm water management measures prior to final stabilization of the site, and are not responsible for maintenance after storm water discharges associated with construction activity have been eliminated from the site. However, post-construction storm water BMPs that discharge pollutants from point sources once construction is completed, may in themselves, need authorization under a separate OPDES permit.

(1) Such practices may include but are not limited to: storm water detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (that combine several practices). The SWP3 shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed predevelopment levels.

(2) Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide a non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g. no significant changes in the hydrological regime of the receiving water).

c. Other Controls.

(1) No solid materials, including building materials, shall be discharged to waters of the State, except as authorized by a permit issued under Section 404 of the CWA.

(2) Off-site vehicle tracking of sediments and the generation of dust shall be minimized.

(3) The SWP3 shall be consistent with applicable State and/or local waste disposal, sanitary sewer or septic system regulations to the extent these are located within the permitted area.

(4) The SWP3 shall include a description of construction and waste materials expected to be stored on-site with updates as appropriate. The SWP3 shall also include a description of controls to reduce pollutants from these materials including storage practices to minimize exposure of the materials to storm water, and spill prevention and response.

(5) The SWP3 shall include a description of pollutant sources from areas other than construction (including storm water discharges from dedicated asphalt plants and dedicated concrete plants), and a description of controls and measures that will be implemented at those sites to minimize pollutant discharges.

(6) The SWP3 shall include a description of measures necessary to

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protect listed endangered or threatened species, or critical habitat, including any terms or conditions that are imposed under the eligibility requirements of the General Permit OKR10 Part I B 3 e (2), unless a determination has indicated that no impact is imminent. Failure to describe and implement such measures will result in storm water discharges from construction activities that are ineligible for coverage under the General Permit OKR10.

d. Approved State or Local Plans.

(1) Permittees which discharge storm water associated with construction activities must ensure their Storm Water Pollution Prevention Plan is consistent with requirements specified in applicable sediment and erosion site plans of site permits, or storm water management site plans or site permits approved by State or local officials.

(2) Storm Water Pollution Prevention Plans must be updated as necessary to remain consistent with any changes applicable to protecting surface water resources in sediment erosion site plans or site permits, or storm water management site plans or site permits approved by State or local officials for which the permittee receives written notice.

1.5.1.3 Maintenance

All erosion and sediment control measures and other protective measures identified in the SWP3 must be maintained in effective operating condition. If site inspections required by General Permit OKR10 Part IV E 4 identify BMPs that are not operating effectively, maintenance shall be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of storm water controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable.

1.5.1.4 Inspections

Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, and locations where vehicles enter or exit the site, at least once every fourteen (14) calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater.

Where sites have been finally or temporarily stabilized, runoff is unlikely due to winter conditions (e.g., site is covered with snow, ice, or frozen ground exists), or during seasonal arid periods in arid areas (areas with an average annual rainfall of 0 to 10 inches) and semi-arid areas (areas with an average annual rainfall of 10 to 20 inches) such inspections shall be conducted at least once every month.

Inspections should at a minimum consist of the following items:

- a. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Sediment and erosion control measures identified in the SWP3 shall be observed to ensure that they are operating correctly. Where discharge locations or

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points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected to the extent that such inspections are practicable. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

b. Based on the results of the inspection, the SWP3 shall be modified as necessary (e.g., show additional controls on map required by General Permit OKR10 Part IV. D. 1; revise description of controls required by General Permit OKR10 Part IV E 2) to include additional or modified BMPs designed to correct problems identified. Revisions to the SWP3 shall be completed within 7 calendar days following the inspection. If existing BMPs need to be modified or if additional BMPs are necessary, implementation shall be completed before the next anticipated storm event. If implementation before the next anticipated storm event is impracticable, they shall be implemented as soon as practicable.

c. A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, and major observations relating to the implementation of the SWP3 shall be made and retained as part of the SWP3 for at least three years from the date that the site is finally stabilized. Major observations should include: the location(s) of discharges of sediment or other pollutants from the site; location(s) of BMPs that need to be maintained; location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; and location(s) where additional BMPs are needed that did not exist at the time of inspection. Actions taken in accordance with General Permit OKR10 Part IV. E. 4. b shall be made and retained as part of the Storm Water Pollution Prevention Plan for at least three years from the date that the site is finally stabilized. Such reports shall identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the facility is in compliance with the Storm Water Pollution Prevention Plan and General Permit OKR10. The report shall be signed in accordance with Part VI. G of the General Permit OKR10.

#### 1.5.1.5 Non-Storm Water Discharges

Except for flows from fire fighting activities, sources of non-storm water listed in Part III. A. 2 or 3 of the General Permit OKR10 that are combined with storm water discharges associated with construction activity must be identified in the SWP3. The SWP3 shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

#### 1.5.1.6 Contractor Certifications

This procedure is initiated only at the discretion of the permittee with the cooperation and agreement of applicable contractor(s). The Contractor Certification form, Addendum D of the General Permit OKR10 should be rewritten by the permittee to fit their specific objectives. Contractor Certification is recommended but is not a requirement of the ODEQ.

a. Contractors, subcontractors, builders, installers, regular suppliers, support service companies or others who are not the permittee involved in construction activity, and have not been issued

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construction general permit authorization, shall execute a Contractor Certification, at the discretion of the permittee, which places the responsibility of complying with and abiding by the intent and purpose of the permit with the contractor for work performed under the authority and direction of the contractor. Contractors must ensure that activities regulated by the Construction General Permit (Permit) are protective of endangered and threatened species and critical habitat according to Part X.

b. Contractors must be thoroughly familiar with and adhere to the Notice of Intent (NOI), the SWP3, and Best Management Practices (BMP). The SWP3 shall clearly identify, for each control measure identified in the plan, the party, which will implement the measure. The Permittee(s) should insure that all contractors or others involved in construction activity identified in the plan as being responsible for implementing storm water control measures, and sign a copy of the contractor certification, before performing any work in the area covered by the Storm Water Pollution Prevention Plan. All contractor certifications should be included with the Storm Water Pollution Prevention Plan.

c. The Contractor Certification should include the name and title of the person providing the signature, the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification is made. An example of an assignment of certification can be found in the General Permit OKR10 Addendum D.

A. A site description, or project description must be developed to include:

1. A description of the nature of the construction activity, potential pollutants and sources;
2. A description of the intended schedule or sequence of major activities that will disturb soils for major portions of the site;
3. The total number of acres of the entire property and the total number of acres where construction activities will occur, including off-site material storage areas, overburden and stockpiles of dirt, and borrow areas;
4. Data describing the soil or the quality of any discharge from the site;
5. A map showing the general location of the site (e.g. a portion of a city or county map);
6. A detailed site map (or maps) indicating the following:
  - a. Drainage patterns and approximate slopes anticipated after major grading activities;
  - b. Areas where soil disturbance will occur;
  - c. Locations of all major structural controls either planned or in place;
  - d. Locations where stabilization practices are expected to be used;

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- e. Locations of off-site material, waste, borrow, fill, or equipment storage areas;
  - f. Surface waters (including wetlands) either adjacent or in close proximity; and
  - g. Locations where storm water discharges from the site directly to a surface water body.
7. The location and description of asphalt plants and concrete plants providing support to the construction site and authorized under this general permit;
8. The name of receiving waters at or near the site that will be disturbed or that will receive discharges from disturbed areas of the project; and
9. A copy of the TPDES General Permit 150000.
- B. The SWP3 must describe the best management practices that will be used to minimize pollution in runoff. The description must identify the general timing or sequence for implementation. At a minimum, the description must include the following components:
- 1. Erosion and Sediment Controls
    - a. Erosion and sediment controls must be designed to retain sediment on-site to the extent practicable with consideration for local topography, soil type, and rainfall. Controls must also be designed and utilized to reduce the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water from the site.
    - b. Control measures must be properly selected, installed, and maintained according to the manufacturer's or designer's specifications. If periodic inspections or other information indicates a control has been used incorrectly, or that the control is performing inadequately, the operator must replace or modify the control as soon as practicable after discovery that the control has been used incorrectly, is performing inadequately, or is damaged.
    - c. Sediment must be removed from sediment traps and sedimentation ponds no later than the time that design capacity has been reduced by 50%.
    - d. If sediment escapes the site, accumulations must be removed at a frequency to minimize further negative effects, and whenever feasible, prior to the next rain event.
    - e. Controls must be developed to limit, to the extent practicable, offsite transport of litter, construction debris, and construction materials.
  - 2. Stabilization Practices
- The SWP3 must include a description of interim and permanent stabilization practices for the site, including a schedule of when the



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practices will be implemented. Site plans should ensure that existing vegetation is preserved where it is possible.

a. Stabilization practices may include but are not limited to: establishment of temporary vegetation, establishment of permanent vegetation, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of existing trees and vegetation, and other similar measures.

b. The following records must be maintained and either attached to or referenced in the SWP3, and made readily available upon request to the parties referenced in Part III.D.1 the Texas General Permit 150000:

(1) The dates when major grading activities occur;

(2) The dates when construction activities temporarily or permanently cease on a portion of the site; and

(3) The dates when stabilization measures are initiated.

c. Stabilization measures must be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and except as provided in (1) through (3) below, must be initiated no more than fourteen (14) days after the construction activity in that portion of the site has temporarily or permanently ceased.

(1) Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceased is precluded by snow cover or frozen ground conditions, stabilization measures must be initiated as soon as practicable.

(2) Where construction activity on a portion of the site is temporarily ceased, and earth disturbing activities will be resumed within twenty-one (21) days, temporary stabilization measures do not have to be initiated on that portion of site.

(3) In arid areas (areas with an average rainfall of 0 to 10 inches), semiarid areas (areas with an average annual rainfall of 10 to 20 inches), and areas experiencing droughts where the initiation of stabilization measures by the 14th day after construction activity has temporarily or permanently ceased is precluded by seasonably arid conditions, stabilization measures must be initiated as soon as practicable.

#### C. Structural Control Practices

The SWP3 must include a description of any structural control practices used to divert flows away from exposed soils, to limit the contact of runoff with disturbed areas, or to lessen the off-site transport of eroded soils.

1. Sediment basins are required, where feasible for common drainage locations that serve an area with ten (10) or more acres disturbed at one time, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained, or equivalent control measures, shall be provided where attainable

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until final stabilization of the site. Where rainfall data is not available or a calculation cannot be performed, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained is required where attainable until final stabilization of the site. When calculating the volume of runoff from a 2-year, 24-hour storm event, it is not required to include the flows from offsite areas and flow from onsite areas that are either undisturbed or have already undergone final stabilization, if these flows are diverted around both the disturbed areas of the site and the sediment basin. In determining whether installing a sediment basin is feasible, the permittee may consider factors such as site soils, slope, and available area on site, public safety, precipitation patterns, site geometry, site vegetation, infiltration capacity, geotechnical factors, depth to groundwater and other similar considerations. Where sediment basins are not feasible, equivalent control measures, which may include a series of smaller sediment basins, must be used. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required for all down slope boundaries (and for those side slope boundaries deemed appropriate as dictated by individual site conditions) of the construction area.

2. Sediment traps and sediment basins may also be used to control solids in storm water runoff for drainage locations serving less than ten (10) acres. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required for all down slope boundaries (and for those side slope boundaries deemed appropriate as dictated by individual site conditions) of the construction. Alternatively, a sediment basin that provides storage for a calculated volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained, or equivalent control measures, may be provided or where rainfall data is not available or a calculation cannot be performed, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained may be provided.

#### D. Permanent Storm Water Controls

A description of any measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed must be included in the SWP3. Permittees are only responsible for the installation and maintenance of storm water management measures prior to final stabilization of the site or prior to submission of an NOT.

#### E. Other Controls

1. Off-site vehicle tracking of sediments and the generation of dust must be minimized.
2. The SWP3 must include a description of construction and waste materials expected to be stored on-site and a description of controls to reduce pollutants from these materials.
3. The SWP3 must include a description of pollutant sources from areas other than construction (including storm water discharges from dedicated asphalt plants and dedicated concrete plants), and a description of controls and measures that will be implemented at those sites to minimize pollutant discharges.

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4. Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide a non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected.

F. Approved State and Local Plans

1. Permittees must ensure the SWP3 is consistent with requirements specified in applicable sediment and erosion site plans or site permits, or storm water management site plans or site permits approved by federal, state, or local officials.

2. SWP3s must be updated as necessary to remain consistent with any changes applicable to protecting surface water resources in sediment erosion site plans or site permits, or storm water management site plans or site permits approved by state or local official for which the permittee receives written notice.

G. Maintenance

All erosion and sediment control measures and other protective measures identified in the SWP3 must be maintained in effective operating condition. If through inspections the permittee determines that BMPs are not operating effectively, maintenance must be performed before the next anticipated storm event or as necessary to maintain the continued effectiveness of storm water controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable. Erosion and sediment controls that have been intentionally disabled, run-over, removed, or otherwise rendered ineffective must be replaced or corrected immediately upon discovery.

H. Inspections of Controls

In the event of flooding or other uncontrollable situations which prohibit access to the inspection sites, inspections must be conducted as soon as access is practicable

1. Personnel provided by the permittee and familiar with the SWP3 must inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, and structural controls for evidence of, or the potential for, pollutants entering the drainage system. Sediment and erosion control measures identified in the SWP3 must be inspected to ensure that they are operating correctly. Locations where vehicles enter or exit the site must be inspected for evidence of off-site sediment tracking. Inspections must be conducted at least once every fourteen (14) calendar days and within twenty four (24) hours of the end of a storm event of 0.5 inches or greater.

Where sites have been finally or temporarily stabilized, where runoff is unlikely due to winter conditions (e.g. site is covered with snow, ice, or frozen ground exists), or during seasonal arid periods in arid areas (areas with an average annual rainfall of 0 to 10 inches) and semi-arid areas (areas with an average annual rainfall of 10 to 20 inches), inspections must be conducted at least once every month.

As an alternative to the above-described inspection schedule of once every fourteen (14) calendar days and within twenty four (24) hours of

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a storm event of 0.5 inches or greater, the SWP3 may be developed to require that these inspections will occur at least once every seven (7) calendar days. If this alternative schedule is developed, the inspection must occur on a specifically defined day, regardless of whether or not there has been a rainfall event since the previous inspection.

2. Utility line installation, pipeline construction, and other examples of long, narrow, linear construction activities may provide inspection personnel with limited access to the areas described in the Texas General Permit 150000 Part III.F.8.(a). Inspection of these areas could require that vehicles compromise temporarily or even permanently stabilized areas, cause additional disturbance of soils, and increase the potential for erosion. In these circumstances, controls must be inspected at least once every fourteen (14) calendar days and within twenty four (24) hours of the end of a storm event of 0.5 inches, but representative inspections may be performed. For representative inspections, personnel must inspect controls along the construction site for 0.25 mile above and below each access point where a roadway, undisturbed right-of-way, or other similar feature intersects the construction site and allows access to the areas described in Part III.F.8.(a) of the Texas General Permit 150000. The conditions of the controls along each inspected 0.25 mile segment may be considered as representative of the condition of controls along that reach extending from the end of the 0.25 mile segments to either the end of the next 0.25 mile inspected segment, or to the end of the project, whichever occurs first. As an alternative to the above-described inspection schedule of once every fourteen (14) calendar days and within twenty four (24) hours of a storm event of 0.5 inches or greater, the SWP3 may be developed to require that these inspections will occur at least once every seven (7) calendar days. If this alternative schedule is developed, the inspection must occur on a specifically defined day, regardless of whether or not there has been a rainfall event since the previous inspection.

3. The SWP3 must be modified based on the results of inspections, as necessary, to better control pollutants in runoff. Revisions to the SWP3 must be completed within seven (7) calendar days following the inspection. If existing BMPs are modified or if additional BMPs are necessary, an implementation schedule must be described in the SWP3 and wherever possible those changes implemented before the next storm event. If implementation before the next anticipated storm event is impracticable, these changes must be implemented as soon as practicable.

4. A report summarizing the scope of the inspection, names and qualifications of personnel making the inspection, the dates of the inspection, and major observations relating to the implementation of the SWP3 must be made and retained as part of the SWP3. Major observations should include: The locations of discharges of sediment or other pollutants from the site; locations of BMPs that need to be maintained; locations of BMPs that failed to operate as designed or proved inadequate for a particular location; and locations where additional BMPs are needed.

Actions taken as a result of inspections must be described within, and retained as a part of, the SWP3. Reports must identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report must contain a certification that the

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facility or site is in compliance with the SWP3 and this permit. The report must be signed by the person and in the manner required by 30 TAC § 305.128 (relating to Signatories to Reports)

I. The SWP3 must identify and ensure the implementation of appropriate pollution prevention measures for all eligible non-storm water components of the discharge.

1.5.1.7 Termination of Coverage

Prepare completed form to terminate coverage under Base permit for Storm Water Discharges from Construction Activities in accordance with Notice of Termination requirements in paragraph entitled SUBMITTALS in this section.

1.6 WASTE MANAGEMENT PLAN

The Contractor shall prepare a Waste Management Plan for the Government's approval. The plan shall be submitted at least 30 days prior to generation of any materials planned for disposal. The plan shall include the following information:

a. Waste Streams and Anticipated Quantities to be Generated: The waste streams shall be estimated, described and tentatively classified into the broad waste types anticipated, such as: hazardous waste (with an EPA waste code); solid waste; medical waste; radioactive waste; mixed hazardous/radioactive waste or other special state waste. The rationale for the assignment of each specific waste type to these broad waste categories shall be provided.

b. Waste Segregation and Temporary Storage: The procedures to be used to segregate wastes of different specific waste types shall be discussed. The temporary storage or staging of these materials shall be discussed and the applicable regulations regarding quantity or time limitations for storage of these materials, spill prevention and control, inspection procedures, container requirements or other required actions shall be referenced. The procedures to be used to insure compliance with these regulations shall be discussed.

c. Treatment, Storage, or Disposal Facilities Name and ID Number for the Anticipated Types of Waste: The type and concentration limits of waste the facility is licensed and permitted to accept shall be included. Copies of the portions of the facility permit authorizing the receipt of the specific waste types anticipated under this contract shall be provided.

d. Analytical/Physical testing required to dispose waste above and beyond that required in other sections of these specifications.

e. Transporters Name and ID Number proposed for use in transporting each specific waste type.

f. Waste container marking and labeling, transport vehicle placarding requirements for each specific waste type.

g. Paperwork Requirements for Disposal of Wastes: For hazardous wastes, the Contractor shall prepare the manifest; the Contracting Officer, Contracting Officer's Representative, or installation representative shall sign the manifest as the generator and shall supply the Generator ID number. Recordkeeping and reporting shall be in accordance with 40 CFR 262 Subpart D - Recordkeeping and Reporting.

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The generator and the Contracting Officer (if different individuals) shall be provided a copy of the manifest after accepted for transport by the transporter. The generator and the Contracting Officer shall also be provided a fully executed copy of the manifest after the waste has been received at the designated disposal or treatment facility. For non-hazardous wastes, the Contracting Officer shall be provided signed documentation from the disposal facility that the quantity and type of waste disposed from the project was accepted at the designated disposal facility.

Waste Management plan shall be submitted to the Contracting Officer for Post Environmental Division review within 15 days after contract award and prior to initiating any site preparation work.

#### 1.6.1 Government Policy

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy, the Contractor shall:

- a. Practice efficient waste management when sizing, cutting, and installing products and materials;
- b. Use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

#### 1.6.2 Management

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste, consideration shall be given to the availability of viable markets, the condition of the materials, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

#### 1.6.3 Waste Management Plan Content

The plan shall have two sections and include the following information:

##### a. Section 1, Special Waste.

(1) Waste Streams and Anticipated Quantities to be Generated: The waste streams shall be estimated, described and tentatively classified. Special wastes include items such as hazardous waste, medical waste, universal waste, radioactive waste, mixed hazardous/radioactive waste; and other special waste. The rationale for the assignment of each specific waste classification

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shall be provided.

(2) Waste Segregation and Temporary Storage: The procedures to be used to segregate wastes of different specific waste types shall be provided. The temporary accumulation or staging of these materials shall be discussed and the applicable regulations regarding quantity or time limitations for storage of these materials, spill prevention and control, inspection procedures, container requirements or other required actions shall be referenced. The procedures to be used to insure compliance with these regulations

(3) Analytical/Physical testing required to dispose waste above and beyond that required in other sections of these specifications.

(4) Waste container marking and labeling, transport vehicle placarding requirements or each specific waste type.

(5) Paperwork Requirements for Disposal of Wastes: For hazardous wastes generated on Fort Sill, the Contractor shall coordinate turn ins and provide transportation of waste to the Post Environmental Division at Building 2592 for proper disposal.

(6) Common items include mercury switches, fluorescent bulbs, lighting ballasts, solvent, paint, coatings, oils, sand or water blast media, cleaning compounds, and others.

(7) Special waste not originally identified shall be reported to the Contracting Officer as soon as practicable to determine disposal requirements.

(8) Asbestos (if applicable) is not included in this plan. Refer to specific specifications for Asbestos Abatement.

b. Section 2, Solid Waste.

(1) Provide the name of individual(s) on the Contractor's staff responsible for waste prevention and management.

(2) Identify actions that shall be taken to reduce solid waste generation.

(3) Describe the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.

(4) Provide characterization, including estimated types and quantities, of the waste to be generated.

(5) Identify local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.

(6) Provide a list of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.

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(7) Identify materials that cannot be recycled/reused with an explanation or justification.

(8) Provide anticipated net cost savings determined by the revenue generated by the sale of the materials and landfill cost savings, less Contractor costs.

#### 1.6.4 Records

Records shall be maintained to document the quantity, in actual or estimated weights, of waste generated, the quantity of waste diverted through sale, reuse, or recycling, the quantity of waste disposed at the Fort Sill Municipal Landfill, and the quantity of waste disposed at the Fort Sill Construction and Demolition Landfill. The records shall be delivered to Fort Sill Environmental Division on a monthly basis, at or near the first week of the month.

#### 1.6.5 Collection

The necessary containers, bins and storage areas to facilitate effective waste management shall be provided and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials.

#### 1.6.6 Disposal

Unless otherwise specified, disposal shall be in accordance with the following:

a. Reuse. First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

b. Recycle. Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

c. Landfill. Materials with no practical use or economic benefit shall be disposed at the Fort Sill Municipal or Construction and Demolition Landfills.

#### 1.7 MEETINGS

The Contractor shall meet with representatives of the Contracting Officer to develop mutual understanding relative to compliance with this section of the specifications and administration of the environment protection program. The Contractor shall be prepared to discuss the program in conferences convened by the Contracting Officer before starting work on each major phase of operation. Approval of the Contractor's plan for environmental protection will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and protection of environmental features. All Contractor personnel shall be required to attend.



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#### 1.8 WATER SYSTEM CONSTRUCTION PERMITS

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

#### 1.9 SUBCONTRACTORS

Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor.

#### 1.10 REGULATORY REQUIREMENTS

The Contractor shall comply with all federal, state, and local regulatory and statutory requirements for all items contained in this section.

#### PART 2 PRODUCTS (NOT APPLICABLE)

#### PART 3 EXECUTION

#### 3.1 PROTECTION OF ENVIRONMENTAL RESOURCES

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the contract drawings or specifications. Environmental protection shall be as stated in the following subparagraphs.

##### 3.1.1 Compliance of Storm Water General Permit for Construction Activity (ADD)

The contractor shall comply with all requirements specified in the Oklahoma Department of Environmental Quality (ODEQ) General Permit OKR10 for storm water discharges from construction activities within the State of Oklahoma. A copy of the OKR10 permit may be found at the following web site: [http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10\\_final\\_permit\\_13\\_sep\\_2002.pdf](http://www.deq.state.ok.us/WQDnew/stormwater/construction/okr10_final_permit_13_sep_2002.pdf)

The Contractor shall be responsible to fully understand the parameters specified with the General Permit OKR10 and determine the permit eligibility of the construction site definition. The Contractor shall complete, sign, and file the Notice of Intent(s) as directed by the General Permit OKR10. The Contractor shall be the permittee and control the activities necessary to ensure full compliance of the conditions within the General Permit OKR10.

See Attachment A, TAFB Section 00 72 00, located at the end of this section for requirements.

The Contractor shall comply with all requirements specified in the Texas Pollution Discharge Elimination System (TPDES) General Permit TXR150000, dated 5 March 2003, or a newer version if applicable. A copy of the TXR150000 General Permit may be found at the following webpage: <http://www.tceq.state.tx.us/>

It shall be the responsibility of the Contractor to fully understand the parameters specified within the TPDES General Permit TXR150000 and determine the permit eligibility of the construction site definition. The Contractor shall complete, sign, and file the Notice of Intent(s) and Notice of Termination(s) as directed by the TPDES General Permit

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TXR150000. This includes all notifications to the applicable municipal separate storm sewer system (MS4) operator(s). The Contractor shall be the permittee and control the activities necessary to ensure full compliance of the conditions within the TPDES General Permit TXR 150000.

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### 3.1.2 Protection of Land Resources

Prior to the beginning of any construction, the Contracting Officer will identify all land resources to be preserved within the Contractor's work area. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without special permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.

The Contractor shall make every effort to preserve land resources within the project boundaries and outside the limits of permanent work performed under this contract in their present condition or they shall be restored to a condition, after completion of construction, that shall appear to be natural and not detract from the appearance of the project. The Contractor shall confine his construction activities to areas defined by the plans and specifications, to areas to be cleared for other operations, or to quarry, borrow or waste areas indicated on plans. At the onset of borrow excavation, topsoil shall be saved for use in restoring the borrow area. Waste and borrow areas shall be leveled or trimmed to regular lines and shaped to provide a neat appearance. In all instances, the restored area shall be well drained, to prevent the accumulation of stagnant water. Except in areas marked on the plans to be cleared, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without approval of the Contracting Officer.

#### 3.1.2.1 Work Area Limits

Prior to any construction, the Contractor shall mark the areas where no work is to be performed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence and during all construction operations. Where construction operations are to be conducted during darkness, the markers shall be visible during darkness. The Contractor shall convey to his personnel the purpose of marking and/or protection of all necessary objects.

#### 3.1.2.2 Protection of Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features to be preserved, indicated and defined on the drawings submitted by the Contractor as a part of the Environmental Protection Plan, shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.

#### 3.1.2.3 Reduction of Exposure of Unprotected Erodible Soils

Earthwork brought to final grade shall be finished as indicated and specified. Side slopes and back slopes shall be protected as soon as

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practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in instances where the constructed feature obscures borrow areas, quarries and waste material areas, these areas shall not initially be cleared in total. Clearing of such areas shall progress in reasonably sized increments as needed to use the areas developed as approved by the Contracting Officer.

#### 3.1.2.4 Temporary Protection of Disturbed Areas

Such methods as necessary shall be utilized to effectively prevent erosion and control sedimentation, including but not limited to the following:

##### a. Retardation and Control of Runoff

Runoff from the construction site shall be controlled by construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses, and the Contractor shall also utilize any measures required by area-wide plans approved under Paragraph 208 of the Clean Water Act.

##### b. Sediment Basins

Sediment from construction areas shall be trapped in temporary or permanent sediment basins in accordance with basin plans shown on the contract drawings [and in accordance with the paragraph: STORM WATER POLLUTION PREVENTION PLANS]. The Contractor shall institute effluent quality monitoring programs as required by state and local environmental agencies.

#### 3.1.2.5 Erosion and Sedimentation Control Devices.

The Contractor shall construct or install all temporary and permanent erosion sedimentation control features as indicated on the contract drawings. Temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing and mulching shall be maintained until permanent drainage and erosion control facilities are completed and operative.

See Attachment A, TAFB Section 00 72 00, located at the end of this section for erosion control requirements for Tinker AFB, OK.

#### 3.1.2.6 Stabilization of Disturbed Soils

Stabilization measures of areas involved in the SWP<sub>3</sub> shall be initiated on disturbed areas as soon as practicable, but no more than 14 days after the construction activity on a particular portion of the site has temporarily or permanently ceased except as follows:

(a) where construction activities will resume on a portion of the site within 21 days from the time when construction activities temporarily ceased;

(b) where the initiation of the stabilization measure is precluded by snow cover in which case stabilization measures shall be initiated as soon thereafter as practicable.

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#### 3.1.2.7 Inspections

Weekly inspections of construction sites shall be conducted by the Contractor to insure that the various controls and components of the various plans required by this section are in place. In addition, the Contractor shall make an inspection within 24 hours following a 1/2 inch or greater rainfall event to insure that the controls are working adequately and have not been impacted by the rainfall event.

The Contractor shall annotate these inspections in a report to be kept on site or at an easily accessible location. The report shall summarize the scope of the inspection, person performing the inspection, the date and time, the major observances relating to the effectiveness of the Storm Water Pollution Prevention Plan, and the corrective actions that were taken, if any. Any instances of non-compliance shall be corrected within 7 days of the inspection.

#### 3.1.2.8 Location of Contractor Facilities

The Contractor's field offices, staging areas, stockpiles, storage, and temporary buildings shall be placed in areas designated on the contract drawings and approved by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only on approval by the Contracting Officer.

#### 3.1.2.9 Borrow Areas on Government Property

Borrow areas on government property shall be managed to minimize erosion and to prevent sediment from entering nearby water courses or lakes.

#### 3.1.2.10 Disposal Areas on Government Property

Disposal areas on Government property shall be managed and controlled to limit material to areas designated on the contract drawings and prevent erosion of soil or sediment from entering nearby water courses or lakes. Disposal areas shall be developed in accordance with the grading plan indicated on the contract drawings.

#### 3.1.2.11 Temporary Excavation and Embankments

Temporary excavation and embankments shall be controlled to protect adjacent areas from contamination.

#### 3.1.2.12 Disposal of Solid Wastes

All waste shall be disposed of in accordance with the approved Waste Management Plan. All handling and transportation shall be the responsibility of the Contractor. Waste shall be handled in such a manner to prevent contamination. The Contractor shall be in compliance with all Federal, state, and local requirements for solid waste disposal.

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. All handling and disposal shall be conducted to prevent contamination. [The Contractor shall transport all solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal.] [Waste materials shall be hauled to the Government landfill site shown on the contract drawings or as directed by the Contracting Officer. The Contractor shall comply with State and local regulations pertaining to the

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use of landfill areas.]

#### 3.1.2.13 Waste Containers

All job site waste containers or compactor used by the Contractor, regardless of size, shall be clearly marked with approved reflective tape or paint. Reflective tape or paint shall be on all corners or waste containers or compactors prior to being placed in roadways. Tape or paint shall be at least 1 1/2 inches wide and 12 inches on each side (24 inches total length each corner; 8 feet each container or compactor). Tape/paint shall be affixed midway on the container. The Contractor shall return all movable containers, as determined by the Contracting Officer, within the job site storage area at the end of each work shift.

#### 3.1.2.14 Disposal of Chemical Wastes

Chemical wastes shall be stored in corrosion resistant containers, removed from the work area and disposed of in accordance with Federal, State, and local regulations.

Chemical wastes shall be stored in appropriate and compatible containers, transported from the work area to the Post Environmental Division, Building 2592, for proper disposal.

#### 3.1.2.15 Disposal of Discarded Materials

Discarded materials other than those which can be included in the solid waste category shall be handled as directed by the Contracting Officer.

See Attachment A, TAFB Section 00 72 00, located at the end of this section for requirements regarding disposal of removed materials.

#### 3.1.2.16 Disposal of Materials at Ft. Sill

Disposal of trash, garbage, or domestic waste shall be in the Ft. Sill Post Sanitary Landfill. Demolition rubble shall be disposed of in the Ft. Sill rubble pit. Disposal of metals shall be the responsibility of the Contractor off Government Property. Disposal of Contractor produced POL products, chemicals, or other hazardous or toxic compounds shall be in accordance with Ft. Sill Regulation USAFACFS Regulation 200-2. The Contracting Officer shall be advised of the type of Contractor produced POL products, chemicals, or other hazardous or toxic compounds and the amount of these products. The Contracting Officer will determine the methods of disposal of these products and such actions may require EPA or State permits.

#### 3.1.2.17 Disposal of Materials in Areas Adjacent to Streams

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

### 3.2 HISTORICAL, ARCHAEOLOGICAL AND CULTURAL RESOURCES

Existing historical, archaeological and cultural resources within the Contractor's work area will be so designated by the Contracting Officer and precautions shall be taken by the Contractor to preserve all such resources as they existed at the time they were pointed out to the Contractor. The Contractor shall install all protective devices such as off-limit markings, fencing, barricades, or other devices deemed necessary by the Contracting Officer for these resources so designated on the contract drawings and shall be responsible for their preservation during this contract. If

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during construction items of apparent archaeological or historical interest are discovered, they shall be left undisturbed and the Contractor shall report the find immediately to the Contracting Officer. [See additional requirements in Attachment A, TAFB Section 00 72 00, located at the end of this section.]

### 3.3 PROTECTION OF WATER RESOURCES

The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface and ground waters. Special management techniques as set out below shall be implemented to control water pollution by the listed construction activities which are included in this contract.

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

#### 3.3.1 Washing and Curing Water

Waste waters directly derived from construction activities shall not be allowed to enter water areas. These waste waters shall be collected and placed in retention ponds where the suspended materials can be settled out or the water evaporated in order to separate the pollutants from the water. [Wash waters and wastes, including chlorinated potable water, shall be processed, filtered, ponded or treated by the Contractor and disposed of off Base at no additional expense to the Government. See Attachment A, TAFB Section 00 72 00, located at the end of this section for additional requirements.]

#### 3.3.2 Cofferdam and Diversion Operations

The Contractor shall plan his operations and perform all work necessary to minimize adverse impact or violation of the water quality standard for [\_\_\_\_], [\_\_\_\_]. Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to limit impact of water turbidity on the habitat for wildlife and impacts on water quality for downstream use.

#### 3.3.3 Stream Crossings

Stream crossings shall be controlled during construction. Crossings shall provide movement of materials or equipment which do not violate water pollution control standards of the Federal, State or local government.

#### 3.3.4 Monitoring of Water Areas Affected by Construction Activities

Monitoring of water areas affected by construction activities shall be the responsibility of the Contractor. All water areas affected by construction activities shall be monitored by the Contractor.

### 3.4 PROTECTION OF FISH AND WILDLIFE RESOURCES

The Contractor shall keep construction activities under surveillance, management and control to minimize interference with, disturbance to and damage of fish and wildlife. Species that require specific attention along with measures for their protection shall be listed by the Contractor prior to beginning of construction operations.

### 3.5 PROTECTION OF AIR RESOURCES

The Contractor shall keep construction activities under surveillance,

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management and control to minimize pollution of air resources. All activities, equipment, processes, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with all Federal and State of Oklahoma emission and performance laws and standards. Special management techniques as set out below shall be implemented to control air pollution by the construction activities which are included in the contract.

#### 3.5.1 Particulates

Dust particles, aerosols, and gaseous by-products from all construction activities, processing and preparation of materials, such as from asphaltic batch plants, shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards mentioned in the paragraph "PROTECTION OF AIR RESOURCES" to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated at such intervals as to keep the disturbed area damp at all times. The Contractor must have sufficient competent equipment available to accomplish this task. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

#### 3.5.2 Hydrocarbons and Carbon Monoxide

Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.

#### 3.5.3 Odors

Odors shall be controlled at all times for all construction activities, processing and preparation of materials.

#### 3.5.4 Monitoring Air Quality

Monitoring of air quality shall be the responsibility of the Contractor. All air areas affected by the construction activities shall be monitored by the Contractor.

#### 3.6 SPRAY FINISHING

See Attachment A, TAFB Section 00 72 00, located at the end of this section, for spray finishing operations (painting).

#### 3.7 ASBESTOS ABATEMENT FOR TINKER AFB

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

#### 3.8 LEAD-BASED PAINT ABATEMENT FOR TINKER AFB

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

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### 3.9 PCB-FILLED BALLAST AND UNIVERSAL WASTE LAMP ABATEMENT FOR TINKER AFB

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

### 3.10 TESTS

The Contractor shall establish and maintain quality control for environmental protection operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations, including, but not limited to the following items. The Contractor shall record on daily reports any problems in complying with laws, regulations and ordinances and corrective action taken. Three copies of these records and tests, as well as the records of corrective action taken, shall be furnished the Government as directed by the Contracting Officer.

#### 3.10.1 Protection of Land Resources

The Contractor shall prevent landscape defacement and provide post-construction clean-up.

#### 3.10.2 Protection of Water Resources

The Contractor shall prevent the contamination of lakes, ditches, or other bodies of water with harmful chemicals; the Contractor shall dispose of waste materials; and the Contractor shall provide erosion control.

#### 3.10.3 Pollution Control Facilities

The Contractor shall maintain all constructed facilities and temporary pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant. The Contractor shall conduct a training course on the maintenance of pollution control facilities.

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

### 3.11 PESTICIDES (INSECTICIDES, FUNGICIDES, HERBICIDES)

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

### 3.12 Spillage and Spill Reporting

See Attachment A, TAFB Section 00 72 00, located at the end of this section.

### 3.13 INSPECTION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with any of the Contractor's required plans. The Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action as may be approved. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or costs or damages allowed to the Contractor for any such suspension.



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### 3.14 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all area(s) used for construction.

### 3.15 RESTORATION OF LANDSCAPE DAMAGE

The Contractor shall restore all landscape features damaged or destroyed during construction operations outside the limits of the approved work areas. Such restoration shall be in accordance with the plans submitted for approval by the Contracting Officer.

See Attachment A, TAFB Section 00 72 00, located at the end of this section for additional requirements.

#### 3.15.1 Damage Report

The Contractor shall furnish a report to the Contracting Officer identifying the date, location, type of facility, and cost to repair the damage. The report shall become a part of the permanent record of the construction contract.

#### 3.15.2 Inspection of Utility Taken Out of Service

The Contractor may request the Contracting Officer or his representative to confirm in his presence with the appropriate utility supervisor (electricity, gas, compressed air, water, etc.) that the utility has been taken out of service (locked out/tagged out) and is safe to work on.

#### 3.15.3 Restoration Requirements for Pavements, Etc.

All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, surface structures, or other Government property affected, damaged, or destroyed directly or indirectly by construction operations in connection with performance of this contract shall be restored to its original condition, as determined and approved by the Contracting Officer. All replacements of surface structures or parts thereof shall be made with new materials conforming to the requirements of the specifications or as approved by the Contracting Officer. Such replacements or repairs shall be made without additional cost to the Government.

### 3.16 RECORD KEEPING

During construction, all records shall be retained onsite. Inspection reports and modifications of the plans required shall be retained for 3 years following construction.

### 3.17 SPECIAL ENVIRONMENTAL REQUIREMENTS FOR ALTUS AFB. (DEC 94)

The following paragraphs describe Altus Air Force Base environmental requirements. Policy letters referenced below may be obtained from the Contracting Office. Reporting shall be coordinated through the Contracting Officer to Altus AFB LG/SEP (phone 580-481-7728 or 5742, Bldg. 228) or CES/CEV (phone 580-481-7605, Bldg. 396) as specified below.

#### 3.17.1 Hazardous Material Registration

Hazardous Material (HM) brought onto Altus AFB shall be registered and shall receive a registration number from LG/SEP. Upon arrival, the registration number shall be applied to its container. After use, the

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quantity of material used shall be reported to LG/SEP along with the disposition of the container.

#### 3.17.2 Drum Registration

Drums (20, 30, and 55 gallon), including drums containing non-regulated material, spare part drums, trash drums, etc., shall receive a registration number prior to transportation onto Altus AFB. The registration number and contents shall be written on two sides of the drum with a paint marker. Registration numbers shall be obtained from LG/SEP. Contractors shall comply with Altus AFB Drum Implementation policy letter (paragraph 1, 2, 2b, 2c, 2e, and 3) dated 23 Feb 94, and Altus AFB Drum Policy letter dated 28 Jan 94, paragraph 2, with the exception that empty drums shall not be returned to the base and no new drums will be issued to Contractors. After use, disposition of drum shall be reported to LG/SEP.

#### 3.17.3 Material Safety Data Sheets (MSDS)

MSDS shall be on file prior to use of listed chemical. Contractors shall comply with Altus AFB MSDS policy letter dated 28 Jan 94.

#### 3.17.4 Flammable Storage Lockers

A list of flammable lockers, their contents, any additions or deletion of contents, and location shall be provided to LG/SEP. Contractors shall comply with Altus AFB Flammable Storage Locker policy letter dated 28 Jan 94.

#### 3.17.5 Hazardous Waste Training

Contractors shall provide proof of personnel hazardous waste training to CES/CEV.

#### 3.17.6 Hazardous Waste Reporting

All Hazardous Waste generated on Altus AFB shall be reported to CES/CEV

#### 3.17.7 Toxic Release Inventory

Contractors shall comply with the reporting requirements for "toxic" chemicals under the Emergency Planning and Community Right to Know Act (EPCRA). Contractors shall report quarterly uses of all toxic chemicals that are estimated to exceed the yearly "minimum threshold quantities" contained in the applicable Code of Federal Regulations required under EPCRA, or 5000 pounds, whichever is less. Reports shall be provided to the Base not later than five working days after the end of each quarter.

#### 3.17.8 Hazardous Waste Satellite Point Conexes/Lockers

If the Contractor accumulates hazardous waste, as defined by the applicable Code of Federal Regulation, a satellite accumulation point with conex/locker shall be established and CES/CEV notified for instructions and coordination. The accumulation point shall comply with Altus AFB Hazardous Waste Satellite Point Conex letter dated 28 Jan 94, except as noted in paragraph 1f.

#### 3.17.9 Spillage and Spill Reporting

At all times, special measures shall be taken to prevent chemicals, fuels,

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oils, greases, bituminous materials, waste washings, herbicides and insecticides, and cement and surface drainage from entering surface or ground waters.

Spills of hazardous waste, hazardous materials, or non-regulated material such as oils, antifreeze, grease, latex paint, hydraulic fluid, etc., that contaminates either soil, surface waters, ground water, or air, shall be reported to CES/CEV immediately for reporting purposes to local, State, and/or Federal agencies and proper clean up actions. If spills occur after office hours or during weekends, the Base Fire Department, (phone 405 481-6333) shall be contacted in order that the CES/CEV standby person may be notified

-- End of Section --

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SECTION 01 58 00.00 10

BULLETIN BOARD, PROJECT SIGN, AND SAFETY SIGN

PART 1 GENERAL

1.1 GENERAL

Immediately upon beginning of work under this contract, the Contractor shall accomplish the work covered in this section. Locations of the bulletin board, project sign, and safety sign shall be as determined by the Contracting Officer. Upon completion of work under this contract, the signs shall be removed from the jobsite and shall remain the property of the Contractor.

PART 2 PRODUCTS

2.1 BULLETIN BOARD

Bulletin board shall be a weatherproof, glass-covered board not less than 36 by 48 inches in size, for displaying the Equal Employment Opportunity Poster, a copy of the wage decision contained in the contract, Wage Rate Information Poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the site of work in a conspicuous place easily accessible to all employees. Legible copies of the above items shall be displayed until work under the contract is complete.

2.2 PROJECT SIGN

The project sign shall be constructed as shown on the drawings at the end of this section. The sign shall receive one coat of primer paint followed by two coats of finish gloss exterior enamel paint, color as directed by the Contracting Officer. Lettering shall be as shown on the drawing and shall be white gloss exterior type enamel.

2.3 SAFETY SIGN

The safety sign shall be located in a conspicuous place within view of all employees and visitors. Details of construction shall be as shown on the drawing attached at the end of this section. Paint shall be gloss exterior enamel. Lettering shall be as shown on the drawing. The Contractor shall keep the safety sign current by posting the numbers daily.

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --



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SECTION 01 60 00.00 50

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 INVENTORY OF DISCONNECTED/REMOVED PROPERTY

The Contractor shall compile a list of equipment or units of equipment disconnected or removed under the terms of this contract that require electrical power or fuel, or may require removal or replacement such as AHU's, fans, air conditioners, compressors, condensers, boilers, thermal exchangers, pumps, cooling towers, tanks, fire hydrants, sinks, water closets, lavatories, urinals, shower stalls, and any other large plumbing fixtures, light fixtures, number of sprinkler heads, number of detection heads, CO<sub>2</sub> and manual systems, etc. The list shall include, on each applicable item, the following:

- Description
- Manufacturer
- Model or Catalog Number
- Serial Number
- Input (Power, Voltage, BTU, etc.)
- Output (Power, Voltage, BTU, Tons, etc.)
- Size or Capacity (Tanks)
- The number of each installed
- The unit cost per item
- Any other data necessary to describe the item

Upon completion of construction, and prior to final inspection, the Contractor shall submit to the Contracting Officer two copies of the inventory of disconnected/removed property. Final acceptance will not be accomplished until the inventory of disconnected/removed property has been received and approved.

1.2 INVENTORY OF INSTALLED PROPERTY

A list shall be made of equipment or units of equipment that require electrical power, water, or fuel, or that may require periodic or eventual removal or replacement. Such items shall include, but not limited to, air handling units; fans; air conditioners; compressors; condensers; boilers; thermal exchangers; pumps; cooling towers; tanks; fire hydrants; large plumbing fixtures such as sinks water closets, lavatories, urinals, and showers; fire suppression systems (sprinkler heads by type, etc.); and light fixtures. The list shall be kept up to date as items are installed or claimed for payment as material on hand. The list will be reviewed periodically by the Government to ensure completeness and accuracy. Partial payment may be withheld for equipment not incorporated in the list at the discretion of the Contracting Officer. The list shall include on each item as applicable: description, manufacturer, model or catalog No., serial No., input (power, voltage, BTU, tons, etc.), size or capacity (e.g. tanks), installation location, net inventory costs; any other data necessary to describe item. Final list shall be turned over to the Contracting Officer 60 days prior to prefinal inspection.

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### 1.3 SCRAP MATERIAL

Materials specified to be removed and become the property of the contractor are designated as scrap, and the bidder should make due allowance in his bid for the value, if any, of such scrap.

### 1.4 MATERIALS FROM GOVERNMENT-OWNED AREAS

Subsequent to contract award, the Contractor may investigate Government-owned areas, not reserved for other purposes, [and except in Osage County,] as potential sources of construction materials to be used only under this contract by him or by his subcontractors. Permission for the use of such additional sources shall be within the discretion of the Contracting Officer only, and if granted, shall be accomplished by separate negotiations in the form of a Change to this contract. It is understood, however, that the Government does not guarantee the availability of such additional sources nor the permission for use of same, if available, and therefore, the successful bidder's plan of operations should not include or be conditioned upon the prospective use of such additional sources. In the production of aggregate (sand or gravel), stone or riprap, or other materials from designated Government-owned land to satisfy the requirements of this contract, any excess materials which are produced by the Contractor over and above requirements for the work will become the property of the Government. Such materials will be left in the stockpiles or wasted in the designated waste areas as normal cleanup, as directed by the Contracting Officer. No materials produced from Government-owned land may be sold by the Contractor except where another Government contract provides for obtaining of material from the Government-owned land. Such sale of materials shall be subject to the approval of the Contracting Officer.

### 1.5 LEAD BASED PAINT

The Army Regulation 420-70 part 2-10(a) directs that lead-based paint (LBP) will not be applied to any Army facility. This regulation defines LBP as "1. Paint in liquid form: LBP is any paint that contains more than 0.06 percent lead by weight (calculated as lead metal) in the total nonvolatile content of the liquid paint, and 2. Paint applied to a surface (in situ): Any paint which tests equal to or greater than 1.0 milligram/cm<sup>2</sup> when using the x-ray fluorescence analyzer or 0.5 percent by weight when using atomic absorption spectroscopic analysis. All paint applied during this project shall comply with the Regulation.

### 1.6 SHEETROCK

Sheetrock which is imported into the United States may contain asbestos fibers at unknown concentrations. Countries such as Mexico and Canada do not have regulatory limitations regarding asbestos or asbestos containing materials. Army Regulation (AR) 200-1, subchapter 8-2(b), directs to "Exclude asbestos from all procurements and uses where asbestos-free substitute materials exist". Furthermore, AR 420-70, Chapter 3 makes reference complying with AR 200-1. The Contractor shall ensure that the gypsum sheetrock applied to this project does not contain any asbestos fibers.

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PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --





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## SECTION 01 67 00

### RECYCLED / RECOVERED MATERIALS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247

Comprehensive Procurement Guideline for  
Products Containing Recovered Materials

##### 1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

##### 1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

##### 1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

##### 1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into

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the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

## 1.6 SUSTAINABLE REQUIREMENTS

### 1.6.1 Credit Validation

The project is required to be registered with USGBC and use LEED online Letter Templates. Payment of fees and administration of the online project will be by the Contractor.

The project is the site portion of a multiple contractor Combined Project and is required to be registered with USGBC. Registration and payment of fees will be by the Contractor. Administration of the online project will be by the Contractor and coordinated with the Government.

### 1.6.2 LEED Credits Coordination

- a. Construction Waste Management: The Contractor shall recycle and/or salvage at least 75% of non-hazardous construction and demolition debris. The Contractor shall develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout.
- b. Recycled Content: The Contractor shall use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 1% (based on cost) of the total value of the materials in the project.

The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in this calculation. Only include materials permanently installed in the project.

Recycled content shall be defined in accordance with the International Organization of Standards document, ISO 14041 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II environmental labeling).

Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.

Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

- c. Regional Materials: The Contractor shall use building materials or

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products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 30% (based on cost) of the total materials value. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project.

#### 1.6.3 Multiple Contractor Combined Project

When site work and building(s) are accomplished by separate contractors, it is a Combined Project for purposes of LEED scoring and documentation. This project is part of a Combined Project that includes separate contracts for the following:

Site Work  
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The LEED-NC Application Guide for Multiple Buildings and On-Campus Projects applies to all Combined Projects that include multiple facilities. The minimum overall Combined Project requirement is to achieve Silver level of Leadership in Energy and Environmental Design (LEED) rating for all nonexempt buildings plus site.

#### 1.7 ADDITIONAL INFORMATION

The detailed requirements regarding use of products containing recycled materials are contained in the technical sections of the specifications. Additional information is available at URL: [www.epa.gov/cpg/products.htm](http://www.epa.gov/cpg/products.htm)

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --



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SECTION 01 70 00.00 10

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals G

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance Instructions," of this section.

SD-11 Closeout Submittals

Record Drawings G

Drawings showing final as-built conditions of the project in accordance with paragraph entitled "As-Built Drawings" of this section.

1.2 WARRANTY OF CONSTRUCTION (APR 1984)

1.2.1 General

See Paragraph "Warranty of Construction" in Section 00 73 00 SPECIAL CONTRACT REQUIREMENTS

1.3 PREWARRANTY CONFERENCE

Prior to contract completion and at a time designated by the Contracting Officer or his representative, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of Paragraph: WARRANTY OF CONSTRUCTION. The Contracting Officer shall establish communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect and reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty.

1.4 RED ZONE MEETING

Approximately 60 days before the anticipated beneficial occupancy date (BOD) at about the 80 percent construction completion stage, the Contractor and the Government's project delivery team will attend a Red Zone Meeting at [the installation][project site] to discuss the project closeout

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process, to schedule events and review responsibilities for actions necessary to produce a timely physical and fiscal project closeout. Based on project requirements, there may follow-on Red Zone Meetings scheduled that the Contractor will be required to attend to discuss status of issued discussed at the initial Red Zone Meeting. The Administrative Contracting Officer will chair the meeting(s). Appendix A, located at the end of this section, contains a generic Red Zone Meeting Checklist.

#### 1.4.1 Red Zone Meeting Review Items

The Contractor shall provide the updated as-built drawings at the Red Zone Meeting. The drawings shall be the complete set of drawings at approximately 50-75 percent completion stage. The drawings shall be in electronic format: one (1) with the original construction drawings (not applicable to Design/Build projects) and two (2) CDs in the customer-required electronic format (see paragraph entitled "Final Drawings (CADD)").

#### 1.5 CONTRACTOR PERFORMANCE EVALUATION

The Contractor is notified that their performance evaluation (CCASS) will include a rating on contract closeout.

#### 1.6 AS-BUILT DRAWINGS

##### 1.6.1 General

The Contractor shall be responsible to prepare and maintain the as-built drawings for this project. "As-built" drawings are a specific and distinct deliverable item under the terms of the contract. Failure to maintain and deliver these drawings will be treated by the Government in a manner similar to the failure to provide a specified item of construction material or equipment.

##### 1.6.2 As-Built Drawing Components

There shall be three (3) components to the as-built drawings:

- a. Working as-built drawings;
- b. Final as-built drawings (dimensionally stable mylar film);
- c. Electronically formatted as-built drawings (CADD files saved to approved media).

##### 1.6.3 Scope of As-Built Drawings.

The as-built drawings shall be a record of the construction as installed and completed by the Contractor. They shall include the information shown on the contract set of drawings and a record of deviations, modifications, or changes from those drawings, however minor, which were incorporated into the work, additional work not appearing on the contract drawings, and changes which are made after final inspection of the work. Level of detail provided on as-built drawings shall match that of the original contract drawings. If additional work changes the as-built conditions after submission of the as-built drawings, the Contractor shall furnish revised or additional drawings to depict as-built conditions. Critical shop drawings or other submittal items, which exceed the level of detail of the as-built drawings and which are needed for the proper operation and maintenance of the project, shall be provided in Operations and Maintenance Manuals.

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#### 1.6.4 GIS Requirements

The Contractor shall provide the elevation inverts of gravity systems for existing elements to remain and new elements within the project limits, elevations of duct bank, underground electric and elevations of any other exposed underground utilities uncovered during construction. The information shall include horizontal location by coordinate. A description of the utility shall be provided. The information shall be provided as a list or on as-builts or other suitable method as approved by the Contracting Officer. The information shall be in a satisfactory manner to be inserted in the installation's GIS database.

#### 1.6.5 Working As-Built Drawings

The Contractor shall maintain two sets of paper prints which shall show the as-built conditions and which shall be kept current and available on the jobsite at all times. One set shall be maintained in the Contractor's on-site office, and the second set will be maintained in the Corps of Engineers' Resident Office. Changes from the contract plans which are made in the work or additional information uncovered in the course of construction shall be accurately and neatly recorded using red ink as they occur by means of details and notes. The as-built marked prints shall be jointly inspected for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. A representative of the Contractor and a representative of the government shall each sign and date the coversheet of the record drawings when reviewed. Failure to submit the working as-builts for review may be considered as an incomplete pay estimate. The drawings shall show the following information, but not be limited thereto:

- a. The location and description of utility lines or other installations of any kind or description known to exist within the construction area. Exterior utilities shall be located in both the horizontal and vertical planes. Dimensions shall be within an accuracy of approximately 100 mm or 4 inches. Vertical location shall be referenced to finished grade or floor level and the horizontal location referenced to a permanent structure such as the face of a building or street curb.
- b. The location and dimensions of changes within the building or structure. Accuracy of dimensions will match the level of accuracy of the original contract drawings. Items depicted symbolically shall use the same symbology of the original drawings. Items depicted on the original drawings without dimensions shall be shown in their approximate actual "as-constructed" location.
- c. Correct grade or alignment of roads, structures, or utilities if changes were made from contract plans.
- d. Correct elevations if changes were made in site grading.
- e. Changes in details of design or additional information obtained from shop drawings prepared or furnished by the Contractor. Information incorporated into as-built drawings shall be at a level of detail consistent with the original drawings.
- f. The topography and grades of drainage constructed or affected as a part of the construction.



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- g. Changes or modifications resulting from the final inspection.
- h. Where contract drawings or specifications allow options, the option selected for construction shall be shown on the as-built drawings.
- i. Working as-built drawings of each drawing shall have the words "DRAWING OF WORK AS-BUILT" in letters at least 3/16-inch high placed below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest existing revision notation.
- j. The title block for additional as-built drawings shall be similar to that used on the original drawings.

#### 1.6.6 Red Zone Meeting As-Built Drawing Requirements

The Contractor shall provide copies of in-progress as-builts drawings in electronic format as required by the paragraph entitled "Red Zone Meeting Review Items" contained in this section.

#### 1.6.7 Final Working As-Built Prints for Review and Approval

Two copies of the working as-built marked prints shall be delivered to the Contracting Officer at the time of final inspection for his review and approval. Upon approval, one copy of the as-built marked prints will be returned to the Contractor. If upon review, the drawings are found to contain errors or omissions, they will be returned to the Contractor for corrections. The Contractor will complete the corrections and return the drawings to the Contracting Officer within 10 calendar days.

#### 1.6.8 Final Drawings

Upon approval of the working as-built prints, the Contracting Officer will furnish the Contractor the original set of contract drawings. These drawings shall be modified to bring them into agreement with the working as-built prints. These drawings are part of the permanent records of the project and the Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer for approval.

##### 1.6.8.1 Draftsmanship

Only personnel proficient in the preparation of engineering drawings to standards satisfactory and acceptable to the Government shall be employed to modify the original contract drawings or prepare additional new drawings. All additions and corrections to the contract drawings shall be neat, clean, and legible and shall match the adjacent existing linework and lettering being annotated in type, density, size, and style. Any pencil work shall be done with plastic lead on plastic base material, or with graphite lead on paper base material. The Contracting Officer will review all as-built drawings for accuracy and conformance to the above specified drafting standards. The Contractor shall make all corrections, changes, additions, and deletions required to meet these standards.

- a. When final revisions have been completed, each drawing shall be lettered or stamped with the words "DRAWING OF WORK AS-BUILT" in letters at least 3/16 inch high placed below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the

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latest existing revision notation. All marking highlighting previous revisions shall be removed.

b. Title Blocks: The title block for additional as-built drawings shall be similar to that used on the original drawings.

#### 1.6.8.2 Reproduction

Blue-line prints shall be full size (equivalent to original drawings) image. All blue-line prints shall exhibit good readable print with clear, sharp, dark lines, and shall not be smeared, faded, double-imaged, or have torn or ragged edges.

#### 1.6.9 Final Submittal

Thirty (30), but not later than 60 days after approval of the redline as-builts, the Contractor shall submit to the Contracting Officer the final as-built original drawings together with the approved working as-built marked prints and one set of final blue-line prints. Paper prints and reproducible drawings will become the property of the Government upon final approval. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

#### 1.6.10 Final Drawings (CAD)

The original drawings have been prepared by Computer Aided Drafting (CAD). These digital files will be provided to the Contractor after contract award. Upon approval of the working as-built prints (paper), the Contractor shall modify the original CAD drawing files to bring them into agreement with the working as-built prints. If additional drawings are required, they shall be prepared in AutoCAD format. All as-built drawings shall adhere to the drawing standards contained in the A/E/C CADD Standards available at <http://tsc.wes.army.mil/products/standards/aec/aecstdweb.asp>. The Contractor shall submit final as-built CAD drawings in AutoCAD Version 2004 or later format.

##### 1.6.10.1 Media

Digital data format shall be as listed below:

5-1/4-in. Read/Write (R/W) Compact Disc (CD) (650, IBM compatible format) (non-compressed).

##### 1.6.10.2 Draftsmanship

Only personnel proficient in the preparation of digital engineering drawings to standards satisfactory and acceptable to the Government shall be employed to modify the original contract drawings or prepare additional new drawings. All additions and corrections to the contract drawings shall be neat, clean, and legible and shall match the adjacent existing linework and lettering being annotated in type, density, size, and style. The Contracting Officer will review all as-built drawings for accuracy and conformance to the above specified drafting standards. The Contractor shall make all corrections, changes, additions, and deletions required to meet these standards.

a. When final revisions have been completed, each drawing shall have the words "DRAWING OF WORK AS-BUILT" in letters at least 3/16 inch high placed below the title block between the border and the trim line. The

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date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest existing revision notation. All markings highlighting previous revisions shall be removed. The Contractor's name shall be placed in the lower right corner of the drawing.

b. Title Blocks: The title block for additional as-built drawings shall be similar to that used on the original drawings.

#### 1.6.10.3 Reproduction

Blue-line prints shall be full size (equivalent to original drawings) image. All blue-line prints shall exhibit good readable print with clear, sharp, dark lines, and shall not be smeared, faded, double-imaged, or have torn or ragged edges.

#### 1.6.11 Final Submittal

Not later than [30][60] days after the approval of the working as-built drawings (redlines), the Contractor shall submit to the Contracting Officer two sets of final as-built drawings on acceptable media as described in paragraph MEDIA above together with one set of approved working as-built marked-up prints, one set of as-built reproducible drawings (mylar), and one set of blue line prints, which will become the property of the Government upon final approval. Format for final as-built drawings shall be as specified in the paragraph FINAL DRAWINGS (CAD) above. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

#### 1.6.12 Final Drawings (CAD)

The original drawings have been prepared by Computer Aided Drafting (CAD). These digital files will be provided to the Contractor after contract award. Upon approval of the working as-built prints, the Contractor shall modify the original CAD drawing files to bring them into agreement with the working as-built prints. If additional drawings are required, they shall be prepared in the MicroStation format. All as-built drawings shall adhere to the drawing standards contained in the A/E/C CADD Standards available at <http://tsc.wes.army.mil/products/standards/aec/aecstdweb.asp>. The Contractor shall submit final as-built CAD drawings in MicroStation Version [J][8] or later format.

##### 1.6.12.1 Media

Digital Data Format shall be as listed below:

5-1/4" Read/Write (R/W) Compact Disc (CD) (650, IBM compatible format) (non-compressed).

##### 1.6.12.2 Draftsmanship

Only personnel proficient in the preparation of digital engineering drawings to standards satisfactory and acceptable to the Government shall be employed to modify the original contract drawings or prepare additional new drawings. All additions and corrections shall be neat, clean, and legible and shall match the adjacent existing linework and lettering being annotated in type, density, size, and style. The Contracting Officer will review all as-built drawings for accuracy and conformance to the above specified drafting standards. The Contractor shall make all corrections,

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changes, additions, and deletions required to meet these standards.

a. Final as-built revisions of each drawing shall have the words "DRAWING OF WORK AS-BUILT" in letters at least 3/16 inch high placed below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest existing revision notation. All marking highlighting previous revisions shall be removed. The Contractor's name shall be placed in the lower right corner of the drawing.

b. The title block for additional as-built drawings shall be similar to that used on the original drawings.

#### 1.6.13 Final Submittal

Not later than [30][60] days after approval of the working as-built drawings (redlines), the Contractor shall submit to the Contracting Officer two sets of final as-built drawings on acceptable media as described in paragraph MEDIA above together with one set of approved working as-built marked-up prints, one set of as-built reproducible drawings (mylar), and one set of blue line prints, which will become the property of the Government upon final approval. Format for final as-built drawings shall be as specified in the paragraph FINAL DRAWINGS (CAD) above. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

### 1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

#### 1.7.1 General

Operating and maintenance (O&M) instructions shall be furnished for equipment and systems as required in the SPECIFICATIONS. The operating and maintenance instructions shall include two separate manuals, an Operations Manual and a Maintenance Manual, and shall include framed instructions when required by the specific section. Each system or piece of equipment shall be covered in the two separate manuals regardless of the number of suppliers or subcontractors involved. Combining more than one system or piece of equipment into the same manuals may be permitted if the manuals are indexed by section and do not exceed 4 inches in thickness. Data submitted for the manual shall be in addition to that furnished as shop drawings. Unless otherwise specified in the SPECIFICATIONS, the Contractor shall assemble six complete bound Operations Manuals and six complete bound Maintenance Manuals. Operations and maintenance data shall be submitted within 30 days after approval of the equipment or system and not less than 60 days prior to scheduled testing. Operations and maintenance data shall also be submitted and approved by the time the project reaches 90 percent completion. If O & M data cannot be completed until equipment or systems have been tested and balanced, a draft copy shall be submitted within the specified time. The completed O&M data shall then be submitted within 30 days after the completion of such testing and balancing.

Unless otherwise authorized by the Contracting Officer, the Government will not accept the equipment or systems nor will the Government take possession of the associated work until O & M data are submitted and approved.

#### 1.7.2 Manuals

Operations and maintenance manuals shall be assembled in a durable stiff

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(hard) covered binder for 8-1/2 by 11-inch sheets with slide binding or screwpost fastening for replacement. Loose-leaf ring binders shall not be used. A permanently printed title on the covers shall show the project name, contract number, and the name of the equipment or system. Shop assembly or special drawings for manuals or parts catalogs shall be of a size that requires folding only a left-to-right coordinate. Each sheet shall be numbered and an index shall be provided. All standard catalog cuts, manufacture's data, parts sheets, or illustrations, shall be originals. A warning page shall be provided to warn of potential dangers, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, or high pressures. The warning page shall be placed inside the front cover or tab page if more than one section is combined, in front of the title page. The title page shall show the name of the preparing firm (designer or contractor) and the date of publication. All non-applicable data such as descriptions of other models and optional equipment not included shall be marked out or all applicable data shall be distinctly highlighted. If reference is made to other drawings or data, they shall be included. Manuals shall include the following information for each item of equipment or system:

#### 1.7.2.1 Operations Manual

The Operations Manual shall show operating procedures, sequences, and precautions. The Contractor shall coordinate subcontractors, suppliers, and manufacturers to assure complete submittals on interrelated components. Include adequate illustrative material to identify and locate operating controls, indicating devices and locations of areas or items requiring operation or adjustments. As a minimum, the manual shall include piping and equipment layout and simplified wiring and control diagrams of the complete system as installed. Describe, in detail, starting and stopping procedures for components, adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Catalog cuts describing equipment operating procedures shall not be used as system operating instructions.

#### 1.7.2.2 Maintenance Manual

The Maintenance manual shall provide instructions for routine and preventive maintenance showing lubrication, dismantling, assembly, repair, and adjustment, electric schematic and connection diagrams, hydraulic circuit diagrams with control and relief valve settings, control and interlock system diagrams, and lists of special tools required. Lubrication instructions shall be for service intended and shall include tables indicating items, frequencies, grades, and types of lubricants. Instructions shall include clearances, bolt torques, pressure settings, and other data. The nature and frequency of routine maintenance and procedures shall be indicated. The materials and test equipment that may be required shall be noted. Performance sheets and graphs, as applicable, showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates shall be included. Marked-up catalogs or catalog pages shall not be used for this purpose. Performance information shall be presented concisely and shall contain only data pertaining to equipment actually installed.

Spare parts data and catalogs showing identification, nomenclature, part numbers, required parts, recommended spare parts stocked, and spare parts supplied shall be included. Local source of parts and dated current price list shall be included. Data shall match equipment furnished. Standard catalog data may be used only if irrelevant parts are marked out or

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relevant parts are clearly identified. Repair information shall show diagrams and schematics, guidance for diagnosing problems, and detailed instructions for making repairs. Troubleshooting information shall be provided that includes a statement of the indication or symptom of trouble and the sequential instructions necessary. Test hookups to determine the cause of trouble, special tools and test equipment, and methods for returning the equipment to operating conditions shall be identified. Information may be in chart form or in tabular format with appropriate headings.

#### 1.7.3 Framed Instructions

Framed instructions shall include as-built schematics of all wiring, controls, piping, etc., necessary for the operation of the equipment or system, and condensed, printed description of the system and of the operating procedure. The framed data may include approved shop drawings, layout drawings, riser and block diagrams and shall indicate all necessary interrelationships with other equipment and systems. The operating instructions shall explain equipment or system prestart checkout, start-up and shut-down procedures, safety precautions, preventive maintenance procedures, and normal operations checks for satisfactory performance of the equipment or system. The framed data may be presented in one or several frames, under glass or plexiglas, for clarity and convenience of location. The framed data presentation and outline shall be acceptable to the Contracting Officer and posted at locations designated by the Contracting Officer. The data shall be posted before personnel training or performance testing acceptance for the related items of equipment or system.

#### 1.8 TRAINING

Formal classroom and on-site training shall be provided as required in other sections of these Specifications. If significant changes or modifications in the equipment or systems are made during the term of the contract after instructions have been concluded, additional instructions shall be provided to acquaint the O&M personnel with the changes or modifications.

The Contractor shall videotape all formal classroom and on-site instruction training sessions. The Contractor shall provide equipment, material and trained personnel to record the sessions using VHS audio-video recording format. Upon completion of the training instructions, the recordings shall become the property of the Government. The recordings shall be identified, indexed, and placed in appropriate approved storage containers for submittal to the Contracting Officer."

#### 1.9 PAYMENT VALUES FOR O&M MANUALS AND AS-BUILT DRAWINGS (SWD LTR 8/2/90 & MEMO ES-Q DTD 1 JUN 94)

##### 1.9.1 O & M Manuals

The estimated value for O&M manuals is considered by the Government to be \$225,000. Payments will be made for this work only upon receipt and approval of O&M data as required in paragraphs "Operating and Maintenance Instructions" and "Training" above. Payment in the amount of 50 percent of the estimated value may be made upon receipt and approval of the draft O&M data as specified in paragraph "Operating and Maintenance Instructions," provided all other submittals have been submitted and approved.

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1.9.2 As-Built Drawings

The estimated value of as-built drawings is considered by the Government to be \$100,000. Payments will be made for this work only upon receipt and approval of final as-built drawings as required in paragraph "As-Built Drawings" above.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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## SECTION 01 74 19

### CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT 01/07

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM INTERNATIONAL (ASTM)

ASTM E 1609 (2001) Development and Implementation of a  
Pollution Prevention Program

##### 1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

##### 1.3 MANAGEMENT

Develop and implement a waste management program in accordance with ASTM E 1609 and as specified. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Environmental Manager, as specified in Section 01 35 10 Environmental Management, shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.



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#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G

SD-11 Closeout Submittals

Records

#### 1.5 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 01 USACE QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

- a. Pre-bid meeting.
- b. Preconstruction.
- c. Regular site meetings.
- d. Work safety meetings.

#### 1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
- c. Description of the regular meetings to be held to address waste management.
- d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.
- e. Characterization, including estimated types and quantities, of the waste to be generated.

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- f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
- g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.
- h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.
- i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.
- j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.
- k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).
- l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

#### 1.7 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

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## 1.8 REPORTS

Provide quarterly reports and a final report to Contracting Officer. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

## 1.9 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 56 01 ENVIRONMENTAL PROTECTION. Separate materials by one of the following methods:

### 1.9.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

- a. Land clearing debris.
- b. Asphalt.
- c. Concrete and masonry.
- d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).
  - (1) Ferrous.
  - (2) Non-ferrous.
- e. Wood (nails and staples allowed).
- f. Debris.
- g. Glass (colored glass allowed).

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h. Paper.

- (1) Bond.
- (2) Newsprint.
- (3) Cardboard and paper packaging materials.

i. Plastic.

- (1) Type 1: Polyethylene Terephthalate (PET, PETE).
- (2) Type 2: High Density Polyethylene (HDPE).
- (3) Type 3: Vinyl (Polyvinyl Chloride or PVC).
- (4) Type 4: Low Density Polyethylene (LDPE).
- (5) Type 5: Polypropylene (PP).
- (6) Type 6: Polystyrene (PS).
- (7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.9.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.9.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.10 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

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1.10.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.10.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.10.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.10.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

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## SECTION 02 08 20

## PRECAST CONCRETE MANHOLES

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Precast concrete manholes for sanitary sewers, storm sewers, and water lines.

Precast concrete sanitary sewer manholes with PVC liner where indicated in Drawings.

## 1.2 REFERENCES

ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings

ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile

ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 270 - Standard Specification for Mortar for Unit Masonry

ASTM C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C 923 - Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes

ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>)

ASTM D 2665 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D 2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe

ASTM D 2997 - Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe

AWWA C 213 - Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines

American Association of State Highway and Transportation Officials (AASHTO)

Oklahoma Department of Transportation Standard Specifications Section 509 Structure Concrete.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

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that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

#### SD-02 Shop Drawings

##### Precast Manholes; G

1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.

Seal submittal drawings by a Professional Engineer registered in the state where the project is being completed.

2. Frames, grates, rings, and covers
3. Materials to be used in fabricating drop connections
4. Materials to be used for pipe connections at manhole walls
5. Materials to be used for stubs and stub plugs, if required
6. Materials and procedures for corrosion-resistant liner and coatings, if required.
7. Plugs to be used for sanitary sewer hydrostatic testing
8. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches

#### SD-05 Design Data

##### Precast Manholes; G

1. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.

Seal submittal drawings by a Professional Engineer registered in the state where the project is being completed.

## PART 2 PRODUCTS

### 2.1 PRECAST MANHOLES

Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.

Provide tops to support AASHTO HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.

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Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Contracting Officer.

Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist the following loads.

1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
4. Internal liquid pressure based on unit weight of 63 pcf
5. Dead load of manhole sections fully supported by transition and base slabs

Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:

1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
2. Wall loading conditions:
  - a. Saturated soil pressure acting on empty manhole
  - b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater

Provide joints between sections with o-ring gaskets conforming to ASTM C 443.

When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.

Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

## 2.2 CONCRETE

Conform to requirements of Section 32 13 14 - Concrete Pavements For Small Projects or ODOT Standard Specification Section 509.

Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.

Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.



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## 2.3 REINFORCING STEEL

Conform to requirements of Section 32 13 14 - Concrete Pavements for Small Projects or ODOT Standard Specification Section 509.

## 2.4 MORTAR

Conform to requirements of ODOT Standard Specifications.

## 2.5 MISCELLANEOUS METALS

Provide cast-iron frames, rings, and covers conforming to requirements of Section 02 08 40 - Frames, Grates, Rings and Covers.

## 2.6 DROP CONNECTIONS AND STUBS

Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

## 2.7 PIPE CONNECTIONS TO MANHOLE

Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:

2. External clamps: Type 304 stainless steel

- c. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.

- d. Internal, expandable clamps on corrosion-resistant manholes:

- 1) Type 316 stainless steel, 11 gauge minimum

- 2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion bonded epoxy conforming to AWWA C 213

3. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.

Storm Sewer Connections:

Provide watertight connections in accordance with ASTM C 923.

Water Lines:

1. Where smooth exterior pipes, i.e., steel, iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless

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steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

## 2.8 SEALANT MATERIALS

Approved products in accordance with Section 01 33 00 - Submittal Procedures.

Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.

Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.

Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

## 2.9 CORROSION RESISTANT MANHOLE MATERIALS

Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide one of the following:

1. PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Section 02 42 70 - Plastic Liner for Large-Diameter Concrete Sewers and Structures.
2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Section 02 08 30 - Fiberglass MANHOLES.

## 2.10 BACKFILL MATERIALS

Conform to requirements of Section 31 00 00 - Earthwork.

## 2.11 NON-SHRINK GROUT

Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.

Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

## 2.12 VENT PIPES

Provide external vent pipes for manholes where indicated on Drawings.

Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.

Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:

1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugal cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive.

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3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.

4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 MILS. COLOR SHALL BE SELECTED BY PROJECT MANAGER FROM MANUFACTURER'S STANDARD COLORS.

## 2.13 PROHIBITED MATERIALS

Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

## 2.14 MANHOLE LADDER

Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings

1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.

Provide approved petroleum-based tape encapsulating bolts in access manhole.

## 2.15 MANHOLE LADDERS/STEPS FOR SANITARY SEWER MANHOLES

Steps shall not be installed Sanitary Sewer Manholes, unless otherwise approved in writing by Contracting Officer.

Ladders shall not be installed in Sanitary Sewer Manholes, unless otherwise approved in writing by Contracting Officer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Verify that lines and grades are correct.

Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.

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Do not build manholes in ditches, swales, or drainage paths unless approved by Contracting Officer.

### 3.2 PLACEMENT

Install precast manholes to conform to locations and dimensions shown on Drawings.

Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

### 3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, or concrete foundation slab.

Unstable Subgrade Treatment: When unstable subgrade is encountered, notify Contracting Officer for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24 inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base.

### 3.4 PRECAST MANHOLE SECTIONS

Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.

Seal any lifting holes with non-shrink grout.

Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.

Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

### 3.5 PIPE CONNECTIONS AT MANHOLES

Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.

1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

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Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.

Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.

Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.

Test connection for watertight seal before backfilling.

### 3.6 INVERTS FOR SANITARY SEWERS

Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum
2. Depth of bench to invert:
  - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
  - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
  - c. Pipes larger than 24 inches: equal to largest pipe diameter
3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

### 3.7 DROP CONNECTIONS FOR SANITARY SEWERS

Backfill drop assembly with crushed stone wrapped in filter fabric or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 4 inches outside bells.

Install drop connection when sewer line enters manhole higher than 24 inches above invert of manhole.

### 3.8 STUBS FOR FUTURE CONNECTIONS

In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

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### 3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.

Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.

For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

### 3.10 BACKFILL

Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 31 00 00 - Earthwork.

Where rigid joints are used for connecting existing sewers to manhole, backfill existing sewer up to springline of pipe with Class B concrete or flowable fill.

In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 31 00 00 - Earthwork. Seed in accordance with Section 32 92 19 - Seeding.

### 3.11 FIELD QUALITY CONTROL

Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Section 02 53 30 - Acceptance Testing for Sanitary Sewers.

### 3.12 PROTECTION

Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to Government.

END OF SECTION



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## SECTION 02 08 40

## FRAMES, GRATES, RINGS, AND COVERS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.

Ring grates.

## 1.2 REFERENCES

AASHTO - American Association of State Highway and Transportation  
Officials Standard Specification for Highway Bridges

ASTM A 48 - Standard Specification for Gray Iron Castings

ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel  
Bars for Concrete Reinforcement

AWS - D 12.1 Welding Reinforcing Steel.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the government. The following shall be submitted in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

## SD-05 Design Data

Castings; G

Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions. All specifications shall be stamped by a licensed professional Engineer in the state of Oklahoma.

## SD-02 Shop Drawings

Castings; G

Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

All specifications shall be stamped by a licensed professional Engineer in the state of Oklahoma.

## PART 2 PRODUCTS

## 2.1 CASTINGS

Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers where indicated on Drawings.



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Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter, unless indicated otherwise.

Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

Manhole covers for Sanitary Sewer Manholes shall be watertight and free of venting holes throughout, unless otherwise indicated on Drawings.

## 2.2 BEARING SURFACES

Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

## 2.3 SPECIAL FRAMES AND COVERS

Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

## 2.4 FINISH

Unless otherwise specified, uncoated cast iron.

## 2.5 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS

Use castings conforming Section 2.01.

One piece casting with dimensions to fit frame and cover.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.

Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

END OF SECTION

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## SECTION 02 08 50

## VALVE BOXES, METER BOXES, AND METER VAULTS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Valve boxes for water service.  
Meter boxes for water service.  
Meter vaults for water service.

## 1.2 REFERENCES

ASTM A 48 - Standard Specification for Gray Iron Castings.  
ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.  
ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.  
ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.  
ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.  
ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

## SD-03 Product Data

Submit manufacturers' product data for following items for approval:

Valve Boxes; G  
Each type of valve box and lid  
Meter Boxes; G  
Each type of meter box and cover  
Meter Vaults; G  
Each type of meter vault frame and cover

## SD-05 Design Data

Submit design calculations and shop drawings for precast vault elements, sealed by a licensed professional Engineer registered in the State of Oklahoma.

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## SD-02 Shop Drawings

Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings; G

## PART 2 PRODUCTS

### 2.1 VALVE BOXES

Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.

Unless otherwise specified, uncoated cast iron.

Riser Pipe.

1. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS.
2. Provide single section of pipe.

Concrete for valve box placement:

1. For locations in new concrete pavement, provide strength and mix design of new pavement.
2. For other locations, provide concrete for sidewalks conforming to requirements of Section 32 16 13 - CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

### 2.2 METER BOXES

Provide meter boxes for 5/8-inch through 1-inch meters of the following materials:

1. Non-traffic bearing locations: Cast iron, concrete or plastic.
2. Traffic bearing locations: Cast iron.

Provide meter boxes for 1 1/2-inch and 2-inch meters of cast iron.

Provide meter box with reading lid. Provide lids with spring-type latching devices. Lids shall contain sufficient metal that meter box can be easily located with metal detector. Cast words "WATER METER" into lid with letters of 1/2-inch height and raised 3/32 inch.

Meter box dimensions shall conform to the following approximate dimensions:

1. Length: At top - 15 1/2 inches; at bottom 20 inches
2. Width: At top - 12 1/2 inches; at bottom 14 3/4 inches
3. Height: 12 inches

Extensions: Meter box extensions 3 inches and 6 inches in height shall be available from manufacturer as standard item.

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### 2.3 CAST-IRON METER BOXES

Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.

Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.

Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

### 2.4 CONCRETE METER BOXES

Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength. Construct to dimensions shown on Drawings.

Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

### 2.5 PLASTIC METER BOXES

Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

| ASTM   | REQUIREMENT   |
|--------|---|
| D 256  | Impact Strength = 1.9 ft.-lb./inch (Izod, Notched)                          |
| D 256  | Impact Strength = 6.4 ft.-lb./inch (Izod, Un-Notched)                       |
| D 638  | Tensile Strength (2.0 min.) = 3400 psi                                      |
| D 648  | Deflection Temperature = 170 degrees F                                      |
| D 2240 | Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb. |
| D 790  | Flexural Modulus = 90,000 psi   |

Meter boxes shall meet the following test requirements:

1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8-inch.

Meter box body, without lid, shall weigh approximately 7 pounds.

### 2.6 METER VAULTS

Meter vaults may be constructed of precast concrete, or cast-in-place concrete unless a specific type of construction is required by Drawings.

Concrete for Meter Vaults: Class A concrete, conforming to requirements of Section 32 13 14 - CONCRETE PAVEMENTS FOR SMALL PROJECTS with minimum compressive strength of 4000 psi at 28 days.

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Reinforcing steel for meter vaults: Conform to requirements of Concrete for Utility Construction.

Grates and Covers: Conform to requirements of Section 02 08 40 - FRAMES, GRATES, RINGS, AND COVERS.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

Obtain approval from Contracting Officer for location of meter vault.

Verify lines and grade are correct.

Verify compacted subgrade will support loads imposed by vaults.

#### 3.2 VALVE BOXES

Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.

1. Install with bell on top of valve
2. Place riser pipe in plumb, vertical position

Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.

Set, align, and adjust valve box so that lid is level with final grade.

Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Contracting Officer, repaint covers black.

#### 3.3 METER BOXES

Install cast iron or plastic boxes in accordance with manufacturer's instructions.

Construct concrete meter boxes to dimensions shown on Drawings.

Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults, below.

Do not locate under paved areas unless approved by Contracting Officer. Use approved traffic type box with cast iron lid when meter must be located in paved areas.

#### 3.4 METER VAULTS

Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.

Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Section 31 00 00 - EARTHWORK.

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2. Seal lifting holes with non-shrink grout.

Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.
2. Precast floor slab elements may be used for precast vault construction.

Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.
2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
3. Set frame for cover in concrete.

### 3.5 FRAME AND COVER FOR METER VAULTS

Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

### 3.6 BACKFILL

Backfill and compact in accordance with Section 31 00 00 - Earthwork.

In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope from top to natural grade.

In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION



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SECTION 02 08 60

ADJUSTING MANHOLES, INLETS, AND VALVE BOXES TO GRADE

PART 1 GENERAL

1.1 SECTION INCLUDES

Adjusting elevation of manholes, inlets, and valve boxes to new grades.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

Provide concrete, conforming to requirements of Section 32 13 14 - CONCRETE PAVEMENT FOR SMALL PROJECTS.

Provide precast concrete manhole sections and adjustment rings conforming to requirements of Section 02 08 20 - PRECAST CONCRETE MANHOLES.

Provide mortar conforming to requirements of Section ODOT Standard Specifications.

2.2 CAST-IRON MATERIALS

Provide cast-iron materials conforming to requirements of Section 02 08 40 - FRAMES, GRATES, RINGS, AND COVERS.

2.3 PIPING MATERIALS

For riser pipes and fittings, refer to Sections 02 50 10 - DUCTILE-IRON PIPE AND FITTINGS through 02 52 80 - POLYETHYLENE WRAP.

PART 3 EXECUTION

3.1 EXAMINATION

Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Contracting Officer.

3.2 ESTABLISHING GRADE

Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.3 ADJUSTING MANHOLES AND INLETS

Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in the following Sections:

1. Section 02 08 20 - PRECAST CONCRETE MANHOLES.

Salvage and reuse cast-iron frame and cover or grate.

Protect or block off manhole or inlet bottom using wood forms shaped to



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fit so that no debris or soil falls to bottom during adjustment.

Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Contracting Officer's approval.

### 3.4 ADJUSTING VALVE BOXES

Salvage and reuse valve box and surrounding concrete block as approved by Contracting Officer.

Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.

Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

### 3.5 BACKFILL AND GRADING

Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Section 31 00 00 - EARTHWORK.

Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.

In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 31 00 00 - EARTHWORK. Provide seeding in accordance with Section 32 92 19 - SEEDING.

-- END OF SECTION --

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SECTION 02 22 20

ABANDONMENT OF SEWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

Abandonment in place of existing sewers, junction structures, manholes, and force mains.

1.2 REFERENCES

ASTM INTERNATIONAL (ASTM)

|             |   |
|-------------|---|
| ASTM C 150  | Standard Specification for Portland Cement  |
| ASTM C 494  | (2005a) Standard Specification for Chemical Admixtures for Concrete   |
| ASTM C 618  | (2005) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete           |
| ASTM C 937  | (2002) Grout Fluidifier for Preplaced-Aggregate Concrete  |
| ASTM C 940  | (1998a; R 2003) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory |
| ASTM C 1017 | (2003) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete                       |
| ASTM C 1107 | (2007) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)                                |

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-05 Design Data

Flowable fill mix design report

Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.

Use of ballast. Provide percentage of ballast of total placement and size limits for ballast if fill is intended to be used with

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ballast.

Aggregate gradation of fill. Aggregate gradation of mix (excluding ballast) shall be used as pilot curve for quality control during production.

Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.

Fill densities and viscosities, including wet density at point of placement.

Initial time of set.

Bleeding and shrinkage.

Compressive strength.

Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

Experience record for proposed crew, showing minimum of 100 cubic yards of flowable fill placed using proposed or similar equipment and methods.

At least 60 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

#### 1.4 DEFINITIONS

##### 1.4.1 Abandonment

Sewer abandonment consists of demolition and removal of portion of manholes existing within specified depth of surface, and abandonment in place of sewer lines and manholes as specified in this Section.

##### 1.4.2 Flowable Fill

Flowable fill (abandonment grout) shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. Long-term hardened strength shall be within specified range.

##### 1.4.3 Ballast

Large aggregate either replaced with voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at same time as flowable fill placement.

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#### 1.4.4 Backgrouting

Secondary stage pressure grouting to ensure that voids have been filled within abandoned sewer. Backgrouting will only be required at critical locations indicated on Drawings or if there is evidence of incomplete flowable fill placements.

### PART 2 PRODUCTS

#### 2.1 FLOWABLE FILL

##### 2.1.1 Design Mix Criteria

Provide design of one or more mixes to meet design criteria and conditions for placement. Present information required by Paragraph 1.05.B in mix design report including following:

- a. Cement: ASTM C 150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.
- b. Fly ash: ASTM C 618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.
- c. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
- d. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100, and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.
- e. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent of natural aggregate to provide workability.
- f. Admixtures: Use admixtures meeting ASTM C 494 and ASTM C 1017 as needed to improve pumpability, to control time of set, and reduce bleeding.
- g. Fluidifier: Use fluidifier meeting ASTM C 937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
- h. Performance additive: Use flowable fill performance additive, such as Darafill or approved equal, to control fill properties.

##### 2.1.2 Flowable Fill Requirements

- a. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
- b. Placement characteristics: self-leveling.
- c. Shrinkage characteristics: non-shrink.

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- d. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C 940
- e. Minimum wet density: 90 pounds per cubic foot.

## 2.2 BALLAST

### 2.2.1 Ballast Material

Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.

### 2.2.2 Ballast Composition

Free of regulated waste material.

## 2.3 PLUGS FOR FORCE MAINS

### 2.3.1 Grout Plugs

Cement-based dry-pack grout conforming to ASTM C 1107, Grade B or C.

### 2.3.2 Manufactured Plug

Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

## PART 3 EXECUTION

### 3.1 PREPARATION

- a. Have fill mix design reports and other submittals required by Paragraph 1.05 accepted by the Contracting Officer prior to start of placement. Notify the Contracting Officer at least 24 hours in advance of grouting with flowable fill.
- b. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- c. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the Contracting Officer. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.
- d. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.
- e. Remove free water prior to starting fill placement.

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### 3.2 EQUIPMENT

- a. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- b. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

### 3.3 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT

- a. Refer to Section 02 41 00 Demolition.
- b. Remove manhole frames and covers and castings from other existing pipeline structures. Deliver castings to nearest quadrant maintenance facility for future use.
- c. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.
- d. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.
- e. Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to Section 31 00 00 - Earthwork. Cut existing force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

### 3.4 INSTALLATION

- a. Abandon sewer lines by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.
- b. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.
- c. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.
- d. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- e. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- f. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable

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fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.

- g. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- h. Remediate placement of flowable fill which does not fill voids in sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.
- i. Plug each end of force main being abandoned.
- j. Force main abandonment
  - 1. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
  - 2. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
  - 3. When using manufactured plug or cap, install fitting as recommended by manufacture's instructions, to form water tight seal.
  - 4. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 00 00 - Earthwork.
  - 5. Collect and dispose of excess flowable fill material and other debris in accordance with Waste Material Disposal or as directed by the Contracting Officer.

### 3.5 FIELD QUALITY CONTROL

- a. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.
- b. Check flow characteristics and workability of fill as placement proceeds.
- c. Obtain at least three test cylinders for each placement area for determination of 56-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.
- d. Record volume of ballast together with flowable fill placement for same space to demonstrate that voids have been filled.

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3.6 PROTECTION OF PERSONS AND PROPERTY

- a. Provide safe working conditions as required by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- b. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

-- End of Section --





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## SECTION 02 41 00

## DEMOLITION

04/06

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K (2005) Containers for Recovered  
Fluorocarbon Refrigerants

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990; R 1998) Safety Requirements for  
Demolition Operations

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD CONSTRUCTION  
SPECIFICATIONS

Section 417 Cold Milling

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2003) Safety -- Safety and Health  
Requirements

## U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (June 2000) Storage and Handling of  
Liquefied and Gaseous Compressed Gases and  
Their Full and Empty Cylinders

## U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M (2000) Requisitioning and Issue Procedures

MIL-STD-129 (Rev P) Military Marking for Shipment and  
Storage

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

40 CFR 82 Protection of Stratospheric Ozone

49 CFR 173.301 Shipment of Compressed Gases in Cylinders  
and Spherical Pressure Vessels

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## 1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the installation daily; do not allow accumulations inside or outside the buildings. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-07 Certificates

Demolition plan; G, AE

Notifications; G, PO

Notification of Demolition and Renovation forms

Proposed demolition and removal procedures for approval before work is started.

## 1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ANSI A10.6.

### 1.4.1 Notifications

#### 1.4.1.1 General Requirements

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), State's environmental protection agency, Ft. Sill DPW Environmental Office and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

If asbestos-containing material (ACM) is present and requires removal, it shall be performed by an individual or firm trained in Asbestos Abatement and licensed with the State of Oklahoma. All subsurface utility lines, new and old, should be located and marked. All previous surveys are now held by DPW. Be advised that the accuracy of these surveys may be limited due to their age and may not satisfy the requirement to "thoroughly inspect" under 40 CFR 61, Subpart M. The contractor is responsible to conduct a complete survey of the subject site (by a licensed asbestos inspector) to verify the amount and condition of the suspected asbestos containing material (ACM). If the survey finds that ACM is still present in excess of the regulatory threshold amounts and requires removal, a National Emission Standard for Hazardous Air Pollutants (NESHAPs) notification (40 CFR 61, Subpart M) shall be completed, signed and provided to EQD (attn: Darek

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Quickle) at least four weeks prior to initiating removal. If the ACM quantities for removal are below the threshold amounts, the NESHAPS notification is not required in advance. Rather it should be provided to EQD at the months end for which removal was completed to satisfy the Operations and Maintenance Program's regulatory reporting requirements. The advanced NESHAP notification is also required for building demolitions. Be advised the regulatory definition of demolition is "the wrecking or taking out of any load-supporting structural member of a facility together with any related handling operations or the intentional burning of any facility." EQD will review the notification and forward to the Oklahoma Department of Environmental Quality - Air Quality Division (ODEQ). Furthermore, regulated asbestos abatement must be performed by an Oklahoma state licensed contractor. questions should be directed to Darek Quickle or Gary Jarnagin (EQD) at (580) 442-5671.

#### 1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the installation and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to public traffic.

#### 1.6 PROTECTION

##### 1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the Contracting Officer prior to beginning such work.

##### 1.6.2 Existing Work

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing work in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, the location and extent of cracks and other damage and description of surface conditions that exist prior to before starting work.

##### 1.6.3 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

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#### 1.6.4 Existing Construction

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

#### 1.6.5 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

#### 1.6.6 Trees

Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

#### 1.6.7 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

#### 1.6.8 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

#### 1.6.9 Protection of Personnel

Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

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#### 1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

#### 1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

#### 1.9 REQUIRED DATA

The Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Provide procedures for safe conduct of the work in accordance with EM 385-1-1.

#### 1.10 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

#### 1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

#### 1.12 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available throughout the project duration.

### PART 2 PRODUCTS

#### 2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition of structures.

### PART 3 EXECUTION

#### 3.1 EXISTING FACILITIES TO BE REMOVED

##### 3.1.1 Structures

a. Remove existing structures indicated to be removed in their entirety. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the

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c. Locate demolition equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

d. Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition.

### 3.1.2 Utilities and Related Equipment

#### 3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

#### 3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location on the installation in accordance with instructions of the Contracting Officer.

#### 3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

#### 3.1.4 Paving and Slabs

Remove cold milled and/or sawcut concrete and asphaltic concrete paving and slabs including aggregate base as indicated to a depth to allow for construction of the final grade. Provide neat sawcuts at limits of pavement removal as indicated. All cold milling of asphalt to be completed in accordance with ODOT Standard Specification Section 417 - Cold Milling Pavement and Section 32 01 16.17 COLD MILLING OF BITUMINOUS PAVEMENTS.

#### 3.1.5 Roofing

Remove existing roof system and associated components in their entirety.

#### 3.1.6 Masonry

Sawcut and remove masonry as indicated.

#### 3.1.7 Concrete

Saw concrete along straight lines to full depth.

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### 3.1.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage and recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated storage area, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

### 3.1.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal to the greatest extent possible as part of demolition operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycle facility.

### 3.1.1.10 Carpentry

Salvage and recycle lumber, millwork items, and finished boards except those that are unfit for reuse. Remove windows, doors and frames and similar items as whole units, complete with trim and accessories. Do not remove hardware attached to units, except for door closers. Brace the open end of door frames to prevent damage.

### 3.1.1.11 Air Conditioning Equipment

Remove air conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning equipment and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

### 3.1.1.12 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

### 3.1.1.13 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

### 3.1.1.14 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit;



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listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated on station storage area as directed by the Contracting Officer. Do not remove equipment until approved.

#### 3.1.14.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

#### 3.1.14.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

#### 3.1.14.3 Ducts

Classify removed duct work as scrap metal.

#### 3.1.14.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris and disposed of by the Contractor.

#### 3.1.15 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

##### 3.1.15.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps, boxed and tagged for identification, and protected from breakage.

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#### 3.1.15.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

#### 3.1.15.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

#### 3.1.15.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

#### 3.1.16 Hoists

Remove hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

### 3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Holes, open basements and other hazardous openings shall be filled.

### 3.3 DISPOSITION OF MATERIAL

#### 3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

#### 3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

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### 3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed at Ft. Sill.

- a. Salvage items and material to the maximum extent possible.
- b. Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.
- c. Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.
- d. Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.
- e. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and deliver to the Ft. Sill Environmental group unless directed otherwise by Contracting Officer.

### 3.3.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer for salvage to Department of Public Works. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82 on site.

#### 3.3.4.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number
- c. Type of ODS and pounds of ODS contained
- d. Date of shipment

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#### 3.3.4.2 Fire Suppression Containers

Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

#### 3.3.5 Transportation Guidance

Shipment of all ODS containers shall be in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

#### 3.3.6 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in the Ft. Sill Sanitary Landfill in accordance with DPW Environmental Requirements. Dispose of combustible material in the sanitary landfill located on the installation.

#### 3.4 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

#### 3.5 DISPOSAL OF REMOVED MATERIALS

##### 3.5.1 Sub Title

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting room removal operations with all applicable federal, state and local regulations as contractually specified at the Ft. Sill Sanitary Landfill. Removed materials shall not be stored on the project site.

##### 3.5.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

##### 3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition structures to designated spoil areas on Government property.

##### 3.5.4 Removal from Government Property

Transport waste materials removed from demolished structures to the Ft. Sill Sanitary Landfill, except waste soil, from Government property for legal disposal. Dispose of waste soil of the installation. All excess clean satisfactory soil shall be delivered to the location noted on the drawings.

-- End of Section --



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## SECTION 02 50 10

## DUCTILE IRON PIPE AND FITTINGS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Ductile iron pipe and fittings for watermains, wastewater force mains, gravity sanitary sewers, and storm sewers.

Related Sections:

1. Section 02 51 10 - WATERMAINS
2. Section 02 53 10 - GRAVITY SANITARY SEWERS
3. Section 02 53 20 - SANITARY SEWAGE FORCE MAINS

## 1.2 REFERENCES

ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.

ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.

ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.

ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.

ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.

ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.

ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.

ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.

ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.

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AWWA C 102 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.

AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.

American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

American Association of State Highway Transportation Officials (AASHTO).

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

#### SD-02 Shop Drawings

Ductile Iron Pipe; G

For pipes 16 inches and greater submit shop drawings signed and sealed by licensed professional Engineer registered in the State of Oklahoma showing the following:

Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Contracting Officer. Provide final approved lay schedule on CD-ROM in Adobe portable document format (\*.PDF).

#### SD-05 Design Data

Ductile Iron Pipe; G

Manufacturer's pipe design calculations.

Calculations and limits of thrust restraint.

Class and length of joint.

#### SD-07 Certificates

Ductile Iron Pipe; G

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Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.

Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.

Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

## PART 2 PRODUCTS

### 2.1 DUCTILE IRON PIPE

Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for watermains and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe.

Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

Modify pipe for cathodic protection in accordance with Cathodic Protection for Pipelines. In lieu of furnishing ductile iron pipe with cathodic protection system, furnish ductile iron pipe with polyethylene encasement, provided the following criteria is met:

1. Provide minimum thickness class.
2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.
3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.05 D.1.
4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).

For use of pressure class pipe for watermains, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = 100 psi.
2. Hydrostatic field test pressure = 150 psi.



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3. Maximum pressure due to surge = 150 psi.
4. Minimum Pressure due to surge = 5 psi.
5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.
6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.
7. Unit weight of fill  $\geq$  120 pcf.
8. Deflection lag factor (DI) = 1.2.
9. Bedding constant (K) = 0.1.
10. Moment coefficient = 0.16.
11. Fully saturated soil conditions hw=h=depth of cover above top of pipe.

Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

Pipe Manufacturer for large diameter watermain: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

| Line Diameter  | Required Bends*                              |
|--|--|
| 20 and 24 inches   | Four 45° bends per 5,000 LF of water line    |
| >24 inches   | Four 22.5° bends per 10,000 LF of water line |
| *Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e., Two 22 ½ ° bends are equivalent to one 45° bend) and will be counted as one fitting. |  |

Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Contracting Officer.

Clearly mark pipe section to show location and thickness/pressure class color coded.

## 2.2 JOINTS

Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.

Where required by drawings, provide approved restrained joints for buried service.

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Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Contracting Officer. When other methods are deemed satisfactory, install at no additional cost to AWS.

## 2.3 GASKETS

Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

## 2.4 FITTINGS

Use fittings of same size as pipe. Reducers are not permitted to facilitate an off size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.

Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.

Ductile Iron Compact Fittings for Water lines: ANSI A 21.53; 4 inch through 12 inch diameter fusion bonded epoxy-lined or cement mortar lining.

## 2.5 COATINGS AND LININGS

Watermain Interiors: ANSI A21.4, cement lined with seal coat; comply with NSF 61.

Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
2. Liner thickness: Nominal 40 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.
3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
4. Acceptable Lining Materials:

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- a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
- b. Ceramic Epoxy - Protecto 401.

Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

Exterior:

1. Watermains

- a. Above Ground (or Exposed): Conform to requirements of Section 02 50 20 - STEEL PIPE AND FITTINGS, Paragraph 2.03.
- b. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.05E.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

Polyethylene Wrap: For buried pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02 52 80 - POLYETHYLENE WRAP.

For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the documents or as indicated by Ft. Sill DPW Environmental office.

For water lines cathodically protected, supply ductile iron pipe with either tape coatings or some other bonded dielectric coating.

2.6 MANUFACTURERS

Use pre-approved manufacturers listed in approved products of the contract document.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to installation requirements of Sections 02 51 10 - WATERMAINS, 02 53 10 - GRAVITY SANITARY SEWERS, and 02 53 20 - SANITARY SEWER FORCE MAINS, except as modified in this Section.

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Install in accordance with AWWA C 600 and manufacturer's recommendations.

Install all ductile iron pipe in double polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

Holiday Testing.

Polyurethane: Provide Polyurethane Coatings for Steel or Ductile Iron Pipe.

Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION



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## SECTION 02 50 30

### COPPER TUBING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

Copper tubing for water service lines.

##### 1.2 REFERENCES

ASTM B 88 - Standard Specification for Seamless Copper Water Tube.

AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

SD-07 Certificates

Copper Tubing; G

Submit certified test results of ASTM B 88.

Submit manufacturer's testing certification that copper tubing conforms to requirements of ASTM B 88. Number of samples for testing of each size of tubing is modified as follows:

1. For each 7500 feet of tubing: 1 sample
2. For each set of tubing less than 7500 feet: 1 sample

#### PART 2 PRODUCTS

##### 2.1 COPPER TUBING

Provide Type K annealed, seamless, copper tubing, 3/8 inch to 2 inch in diameter conforming to requirements of ASTM B 88.

Provide 3/8-inch and 1-inch tubing in coils of minimum 60 feet in length, and 1 1/2 inch and 2-inch tubing in coils 40 feet in length.

Provide tubing manufactured in United States of America. Tubing shall be inspected and tested by a certified laboratory approved by Contracting Officer at point of manufacture or locally. Furnish tubing, at no additional cost to designated testing laboratory along with mill compliance certificates.

Provide flared or compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C 800.

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### PART 3 EXECUTION

#### 3.1 INSTALLATION

Conform to installation requirements of Section 02 51 20 - Water Tap and Service Line Installation, except as modified in this Section.

#### 3.2 JOINTS

Minimum joint spacing for 3/4-inch and 1-inch tubing shall be 60 feet and for 1-1/2 inch and 2-inch tubing shall be 40 feet.

Cut copper tubing squarely by using cutting tools designed specifically for purpose and avoid procedures that cause pipe to bend or pipe walls to flatten.

After tubing has been cut, but before flaring, use reamer to remove inside rolled lip from tubing. Expand flared ends by use of flaring tool using care to avoid splitting, crimping, or over stressing metal. Provide at least 10 inches of straight pipe adjacent to fittings.

When compression fittings are used, cut copper tubing squarely prior to insertion into fitting. Assemble in accordance with manufacturer's recommended procedure.

#### 3.3 BENDS

Bend tubing by using appropriate sized bending tool. No kinks, dents, flats, or crimps shall be permitted. Cut out and replace damaged section. Install no bends with radius smaller than radius of coil of tubing as packaged by manufacturer. Copper tubing shipped in straight lengths conforms to the following:

1. For 2-inch diameter: Maximum of one 45-degree bend per 4-foot section.
2. For 1 1/2-inch diameter: Maximum of one 45-degree bend per 3-foot section.

END OF SECTION

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## SECTION 02 50 50

HIGH DENSITY POLYETHYLENE (HDPE)  
SOLID AND PROFILE WALL PIPE

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.

High density polyethylene (HDPE) pipe for sanitary sewer forcemains, including fittings.

High density polyethylene (HDPE) pipe for storm sewers culverts.

## Related Sections:

1. Section 31 00 00 - EARTHWORK
2. Section 02 53 10 - GRAVITY SANITARY SEWERS
3. Section 02 53 30 - ACCEPTONE TESTING FOR SANITARY SEWERS
4. Section 01 33 00 - SUBMITTAL PROCEDURES

## 1.2 REFERENCES

AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"- 48" diameter.

AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.

AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.

ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.

ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.

ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyethylene Pipe and Fittings.

ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.



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ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

SD-02 Shop Drawings

High Density Polyethylene Pipe; G

Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

### 1.4 QUALITY CONTROL

Provide manufacturer's certificate of conformance to Specifications.

Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

Contracting Officer reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.

1. Manufacturer's Notification: Should Contracting Officer wish to witness manufacture of specific pipes, manufacturer shall provide Contracting Officer with minimum three weeks notice of when and where production of those specific pipes will take place.

2. Failure to Inspect. Approval of products or tests is not implied by Contracting Officer's decision not to inspect manufacturing, testing, or finished pipes.

### 1.5 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

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## PART 2 PRODUCTS

### 2.1 HIGH DENSITY POLYETHYLENE PIPE

For sewer pipe provide HDPE pipe as follows:

#### 1. NEW CONSTRUCTION PIPE PRODUCTS GRAVITY SANITARY SEWER DIRECT BURY

| Installation Spec No. | Generic Name              | Trade Name or Manufacturer  | ASTM  | SDR (Numeric Maximum) | Pipe Stiffness (Numeric Minimum) | Size Range                        |
|-----------------------|---------------------------|---|-------|-----------------------|----------------------------------|-----------------------------------|
| 02 55 00              | Solid Wall Poly           | Chevron Plexco<br>Quail Poly Pipe<br>AmeriFlow by<br>NAPCO<br>AmeriFlow by<br>KWH | F-714 | DR 21                 | 46                               | 8" - 48"<br>3" - 12"<br>14" - 63" |
| 02 55 00              | Polyethylene Profile Wall | Spirolite   | F-894 | n/a                   | 46                               | 18" - 120"                        |

#### 2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

| Installation Spec No. | Generic Name              | Trade Name or Manufacturer  | ASTM  | SDR (Numeric Maximum) | Pipe Stiffness (Numeric Minimum) | Size Range                        |
|-----------------------|---------------------------|---|-------|-----------------------|----------------------------------|-----------------------------------|
| 02 55 00              | Solid Wall Poly           | Chevron Plexco<br>Quail Poly Pipe<br>AmeriFlow by<br>NAPCO<br>AmeriFlow by<br>KWH | F-714 | DR 21                 | 46                               | 8" - 48"<br>3" - 12"<br>14" - 63" |
| 02 55 00              | Polyethylene Profile Wall | Spirolite   | F-894 | n/a                   | 46                               | 18" - 120"                        |

Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.

Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.

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#### Jointing:

##### 3. Gaskets:

- a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both,
- b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

| CONTAMINANT                  | GASKET MATERIAL REQUIRED            |
|------------------------------|-------------------------------------|
| Petroleum (diesel, gasoline) | Nitrite Rubber                      |
| Other Contaminants           | As recommended by pipe manufacturer |

4. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

## 2.2 MATERIALS FOR SANITARY SEWER

Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.

Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

## 2.3 TEST METHODS FOR SANITARY SEWER

Conditioning. Conditioning of samples prior to and during tests is subject to approval by Contracting Officer. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

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Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.

Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

## 2.4 MARKING

Mark each standard and random length of pipe in compliance with these Specifications with following information:

1. Pipe size.
2. Pipe class.
3. Production code.
4. Material designation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Conform to requirements of following Sections:

1. Section 02 53 10 - GRAVITY SANITARY SEWERS.
2. Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS.

Install pipe in accordance with the manufacturers recommended installation procedures.

HDPE pipe is not approved in applications requiring auguring of pipe.

Bedding and backfill: Conform to requirements of Section 31 00 00 - EARTHWORK.

END OF SECTION



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## SECTION 02 50 60

## POLYVINYL CHLORIDE PIPE

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 16 inches.

Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.

## Related Sections:

1. Section 02 51 10 - WATERMAINS
2. Section 02 53 10 - GRAVITY SANITARY SEWERS
3. Section 01 33 00 - SUBMITTAL PROCEDURES
4. Section 31 00 00 - EARTHWORK

## 1.2 REFERENCES

ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

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ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC)  
Corrugated Sewer Pipe with Smooth Interior and Fittings.

AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron  
Fittings, 3 Inches Through 48 Inches for Water.

AWWA C 111 - American National Standard for Rubber-Gasket Joints for  
Ductile-Iron Pressure Pipe and Fittings.

AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4  
Inches Through 12 Inches for Water Distribution.

AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and  
Distribution.

AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVC)  
Pressure Pipe, 4 Inches through 12 Inches (100 mm through 300 mm), for  
Water Distribution.

PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic  
Design Stresses for Thermoplastic Pipe Materials.

UNI-B-13 - Recommended Standard Performance Specification for Joint  
Restraint Devices for Use with Polyvinyl Chloride Pipe.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;  
submittals not having a "G" designation are for information only. When  
used, a designation following the "G" designation identifies the office  
that will review the submittal for the Government. The following shall  
be submitted in accordance with Section 01 33 00 - Submittal  
Procedures:

SD-02 Shop Drawings

Polyvinyl Chloride Pipe; G

Submit shop drawings showing design of new pipe and fittings  
indicating alignment and grade, laying dimensions, fabrication,  
fittings, flanges, and special details; G

### 1.4 QUALITY CONTROL

Submit manufacturer's certifications that PVC pipe and fittings meet  
requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905  
for pressure pipe applications, or appropriate ASTM standard specified  
for gravity sewer pipe.

Submit manufacturer's certification that PVC pressure pipe for water  
lines and force mains has been hydrostatically tested at factory in  
accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this  
Section.

When foreign manufactured material is proposed for use, have material  
tested for conformance to applicable ASTM requirements by certified  
independent testing laboratory located in United States. Certification  
from other source is not acceptable. Furnish copies of test reports to  
Contracting Officer for review. Cost of testing paid by Contractor.

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## PART 2 PRODUCTS

### 2.1 POLYVINYL CHLORIDE PIPE

Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

PVC Restrained Pipe: Must be listed on American Water's (AW's) current Product Approval List.

#### 1. Pipe Material:

- a. DR 18: For restrained joints where shown on Drawings.
- b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.

#### Water Service.

1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to State Fire Insurance Committee for use in fire protection lines.

2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

#### Gaskets:

1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

Do not use PVC in potentially or known contaminated areas.

Do not use PVC in areas exposed to direct sunlight.

### 2.2 WATER SERVICE PIPE

Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

Pipe 14 inch through 16 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.



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Provide Polyvinyl Chloride Pipe from approved manufacturers.

Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Contracting Officer.

Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

### 2.3 GRAVITY SEWER PIPE

PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

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| WALL<br>CONSTRUCTION | MANUFACTURER                       | ASTM<br>DESIGNATION | SDR (Max)<br>STIFFNESS<br>(MIN.) | DIAMETER<br>SIZE RANGE |
|----------------------|------------------------------------|---------------------|----------------------------------|------------------------|
| Solid                | 7-M Pipe<br>CertainTeed<br>Diamond | D3034               | SDR 26 IPS                       | 6" to 10"              |
|                      |                                    | D3034               | SDR 35 IPS<br>46                 | 12" & 15"              |
|                      | Uponor ETI<br>North American       | F679                | SDR 35 I PS<br>46                | 18" to 27"             |
|                      |                                    | AWWA C900           | DR 18 /NIA                       | 4" to 12"              |
|                      |                                    | AWWA C909           | DR 181 NIA                       | 4" to 12"              |
|                      |                                    | AWWA C905           | DR 18 /NIA                       | 14" to 16"             |
| Truss<br>(Gasketed)  | Contech                            | D2680               | N/A /200<br>psi                  | 8" to 15"              |
| Profile              | Contech A-2000                     | F949                | N/A 146<br>psi                   | 12" to 36"             |
|                      | Contech A-2026                     | F949                | N/A 1115<br>psi                  | 8" to 10"              |
|                      | ETI, Ultra-Rib                     | F794                | N/A 146 psi                      | 8" to 30"              |
|                      | ETI, Ultra-Cory                    | F794                | N/A 146 psi                      | 24" to 36"             |

- A. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- B. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- C. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.
- D. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- E. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Contracting Officer. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests

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under same conditions of temperature and humidity unless otherwise specified.

- F. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch in length.
- G. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- H. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- I. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

#### PART 3 EXECUTION

##### 3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

##### 3.2 INSTALLATION

- A. Conform to requirements of Section 02 51 10 - Watermains and Section 02 53 10 - Gravity Sanitary Sewers, as applicable.
- B. Install PVC pipe in accordance with Section 31 00 00 - Earthwork, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
  - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
  - 2. Water service pipe 16 inches in diameter and larger 5 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.

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- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

### 3.3 PVC RESTRAINED MECHANISM

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.
- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
  - 1. Perform by workers certified by manufacturer.
  - 2. Use a PVC pipe cutter and provide square ends.
  - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION



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## SECTION 02 51 10

### WATERMAINS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

Installation of watermains.

Specifications identify requirements for both small diameter watermains and large diameter watermains. When specifications for large diameter watermains differ from those for small diameter watermains, large diameter specifications will govern for large diameter pipe.

Related Sections:

1. Section 02 51 50 - HYDROSTATIC TESTING OF PIPELINES
2. Section 02 51 40 - DISINFECTION OF WATER LINES
3. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS
4. Section 02 50 60 - POLYVINYL CHLORIDE PIPE (PVC)
5. Section 31 00 00 - EARTHWORK
6. Section 32 13 14 - CONCRETE PAVEMENTS FOR SMALL PROJECTS
7. Section 02 52 80 - POLYETHYLENE WRAP

##### 1.2 REFERENCES

ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile- Iron Pressure Pipe and Fittings.

ANSI/NSF Standard 61 - Drinking Water System -Health Components.

ASTM A 36 - Standard Specification for Carbon Structural Steel

ASTM A 536 - Standard Specification for Ductile Iron Castings

ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes.

ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar.

ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.

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ASTM E 165 - Standard Test Method for Liquid Penetrant Examination

ASTM E 709 - Standard Guide for Magnetic Particle Examination

ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe.

AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submittal in accordance with Section 01 33 00 - Submittal Procedures:

#### SD-03 Product Data

Pipe Materials; G

Conform to submittal requirements of applicable Section for type of pipe used.

Construction Photographs to be taken prior to commencement of construction with both the Contractor and the Contracting Officer to be present.

Submit videotapes conforming to requirements of Construction Videotapes, if applicable.

Submit proper notification transmittal number prior to beginning excavation.

Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:

Disinfection; not to exceed 4,000 linear feet per section.

Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.

Site restoration; not to exceed limits specified; Sequence in order of disturbance.

## PART 2 PRODUCTS

### 2.1 PIPE MATERIALS

Install watermain pipe materials, which conform to following:

1. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS.

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## 2. Section 02 50 60 - POLYVINYL CHLORIDE PIPE (PVC).

Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.

Type of pipe materials used is Contractor's option unless specifically identified on Drawings.

Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

### 2.2 RESTRAINED PIPE JOINTS

Ductile-Iron Pipe (DI): Refer to Section 02 50 10 - Ductile Iron Pipe and Fittings.

PVC Pipe: Refer to Section 02 50 60 - Polyvinyl Chloride Pipe (PVC). Perform hydrostatic testing in accordance with ASTM F 1674.

Restrained Joints where required on DI and PVC pipe:

1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

## PART 3 EXECUTION

### 3.1 PREPARATION

Conform to applicable installation specifications for types of pipe used.

Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.

Lay pipe to lines and grades shown on Drawings.

Confirm that eight (8) feet minimum separation from gravity sanitary sewers and manholes or separation of four (4) feet minimum from forcemains as specified in this Section in all directions unless special design is provided on Drawings.

Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Contracting Officer before proceeding with construction.

Inform Contracting Officer if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Contracting Officer.



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Contractor shall coordinate with Ft. Sill DPW for operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers. Ft. Sill DPW shall coordinate with AW on-site field staff for operation involving water line/valve opening or closing.

If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's (AWWA) publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.

Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.

Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Contracting Officer.

### 3.2 HANDLING, CLEANING AND INSPECTION

#### Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
4. For large diameter watermain pipes, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
5. Use precautions to prevent injury to pipe, protective linings and coatings.
  - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
  - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
  - c. Do not lift pipe using hooks at each end of pipe.
  - d. Do not place debris, tools, clothing, or other materials on pipe.

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6. Repair damage to pipe or protective lining and coating before final acceptance.
7. For cement mortar line permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe.
8. Reject pipe with visible cracks and remove from project site.

Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.

Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

### 3.3 EARTHWORK

Conform to applicable provisions of Section 31 00 00 - EARTHWORK.

Bedding: Use bedding materials in conformance with Section 31 00 00 - EARTHWORK.

Backfill: Use bank run sand or earth or native soil as specified in Section 31 00 00 - EARTHWORK. Backfill excavated areas in the same day they were excavated for paved streets. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.

Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Water tamping is not allowed.

Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

### 3.4 PIPE CUTTING

Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Contracting Officer. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

### 3.5 PIPING INSTALLATION

General Requirements:

1. Lay pipe in sub grade free of water.
2. Make adjustments of pipe to line and grade by scraping away sub grade or filling in with granular material.
3. Properly form bedding to fully support bell without wedging or blocking up bell.

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4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe.

Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Contracting Officer prior to skipping any portion of Work.

Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

Perform Critical Location as shown on Drawings. Refer to 31 00 00 - EARTHWORK for additional requirements at critical locations.

For tie-ins to existing watermain, provide necessary material on hand to facilitate connection prior to shutting down existing watermain. Provide Contracting Officer a minimum of two weeks notice prior to shutting down existing watermain.

### 3.6 JOINTS AND JOINTING

Rubber Gasketed Bell-and-Spigot Joints for PVC, Steel, and DIP:

1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.
5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
  - a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.

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- b. Do not include passive resistance of soil in thrust restraint calculations.
6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other type of stops as approved by Contracting Officer.

Flanged Joints where required on Ductile Iron Pipe:

1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
3. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Denso petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.
4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with the most recent edition of reference material published by the American Water Works Association (AWWA).
5. PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.

Restrained Joints

1. For existing watermain less than 16 inches in diameter, affected by new watermain construction, restrain existing pipe joints with concrete thrust blocks. For all new watermain construction, use thrust restraint glands for the pipe lengths either side of the mechanical joint fittings as shown on the Drawings and or as specified.
2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of pre-stressed concrete pressure pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer for the State of Oklahoma, for review by Contracting Officer. Make adjustments

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- in thrust restraint lengths at no additional cost to Government.
3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
  4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
  5. Installation.
    - a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
    - b. Examine and clean mechanism; remove dirt, debris and other foreign material.
    - c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
    - d. Verify gasket is evenly seated.
    - e. Do not over stab pipe into mechanism.
  6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
  7. Place concrete conforming to Section 32 13 14 - Concrete Pavements For Small Projects, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of new watermain. Test may be made 2 days after completion of blocking if Type II cement is used.

Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Contracting Officer. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
3. If deflection is equal to or exceeds 5% from that specified, remove entire portion of deflected pipe section and install new pipe.
4. Replace, repair, or reapply coatings and linings as required.
5. Assessment of deflection may be measured by Contracting Officer at any location along pipe. Arithmetical averages of deflection

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or similar average measurement methods will not be deemed as meeting intent of standard.

6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.

### 3.7 SECURING, SUPPORTING AND ANCHORING

Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.

Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and Subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

### 3.8 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE

Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.

Conform to requirements of Section 02 52 80 - Polyethylene Wrap.

### 3.9 CLEANUP AND RESTORATION

Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old watermains, backfill and surface restoration.

Unless otherwise approved by Contracting Officer, comply with the following;

1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
2. No later than three days after completing disinfection preparatory work, submit to Contracting Officer appropriate request for disinfection.
3. If Contractor fails to perform initial disinfection of lines in accordance with Section 02 51 40 - Disinfection of Water Lines, within seven days from submission of appropriate request, and if approved by Contracting Officer, pipe laying operations may continue beyond approved limits until the AWS responds.

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4. Immediately after transfer of services, begin abandonment of old watermains and site restoration.
5. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Site Restoration contract specifications. Allow access to adjacent construction sites. Coordinate with Contracting Officer and adjacent contractors.
6. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

For large diameter watermains, do not install more than 2,000 linear feet of watermain, without the previous 2,000 linear feet being restored. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet.

### 3.10 TRACING WIRE

Tracing wire is to be installed on all new watermain pipe for future locating purposes regardless of the watermain pipe material. A solid #12 gauge, TWU copper wire is to be installed along the top of the pipe, taped to the pipe at 20-foot intervals. All costs for the supply and installation of the tracing wire shall be included as part of the unit price bid for watermains.

The wire is to be installed between each valve and/or the end of the new watermain. Joints in the wire between valves are not permitted. At each valve (including fire hydrant isolation valves), a loop of wire is to be brought up the outside of the valve box and looped inside the box through a hole drilled 2 inches below the bottom of the lid as per tracer wire installation drawing.

The Contracting Officer may test the tracing wire for conductivity. If the tracing wire is not continuous the contractor shall, at his own expense, replace or repair the wire.

### 3.11 WATERMAIN WARNING TAPE

Watermain "Underground Warning Tape" is to be installed for all new watermain pipe installations for the purpose of protecting the watermain during future excavation in the vicinity regardless of the watermain pipe material. The Warning Tape as a minimum shall be 3 inches wide, 3.5-mil polyethylene, "blue" in color, with the wording "CAUTION - BURIED WATERLINE BELOW." All costs for the supply and installation of the underground watermain warning tape shall be included as part of the unit price bid for watermains.

The "Underground Warning Tape" is to be installed below the granular road base materials in order to provide a final depth of bury for the tape as being approximately 15 inches below the final road surface. Splice/over laps in the tape to be a minimum of 12 inches in length.

### 3.12 CLEANING PIPING SYSTEMS

Remove construction debris or foreign material and thoroughly swab clean and flush piping systems. Provide temporary connections,

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equipment and labor for cleaning. Contracting Officer must inspect watermain for cleanliness prior to filling.

3.13 DISINFECTION OF WATERMAINS

Conform to requirements of Section 02 51 40 - DISINFECTION OF WATERMAINS.

3.14 FIELD HYDROSTATIC TESTS

Conform to requirements of Section 02 51 50 - HYDROSTATIC TESTING OF PIPELINES.

END OF SECTION





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## SECTION 02 51 20

### WATER TAP AND SERVICE LINE INSTALLATION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

Tapping existing and or new watermains and furnishing and installing new service lines for water.

Relocation of existing small water meters.

Specifications identify requirements for small-diameter (less than or equal to 20 inches) watermains.

Related sections:

1. Section 02 50 30 - COPPER TUBING
2. Section 31 00 00 - EARTHWORK

##### 1.2 REFERENCES

AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution.

##### 1.3 DEFINITIONS

Short Side Connection Service Line: Installation of a new corporation main stop and connecting a new length of proposed water service piping between the new proposed watermain to the existing water service piping connected to the existing watermain located on same side of street as to where the new watermain is being constructed.

Long Side Connection Service Line: Installation of a new corporation main stop, and connection to the existing water service piping that provides water service to the buildings on the opposite side (long side) of the street from of the centerline of the proposed new watermain.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

Copper Tubing: In accordance with Section 02 50 30 - COPPER TUBING. Where existing service piping is determined to be 'Copper' new service piping shall be 'Copper Tubing' to match existing.

Corporation Main Stops: AWWA C 800 as modified in this Section:

1. Inlet End: AWWA standard thread.

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2. Valve Body: Tapered plug type, O-ring seat ball type, or rubber seat ball type.
3. Outlet End: Flared-copper connection for use with Type K, soft copper or compression type fitting.

Provide taps for water line types and sizes in accordance with pipe tapping schedule located at end of this Section.

Dual Strap Saddles: Red brass body and straps; ductile-iron; vinyl-coated body and straps; or ductile-iron, vinyl-coated body and stainless-steel straps.

Taps for PVC Watermains: Use dual-strap or single, wide-band strap saddles which provide full support around circumference of pipe and bearing area of sufficient width along axis of pipe, 2 inches minimum, ensuring that pipe will not be distorted when saddle is tightened. Provide approved stainless-steel tapping saddle with AWWA standard thread.

Taps for Steel Pipe: Not allowed, unless specifically approved by Contracting Officer. Use saddle only when tap is approved on steel pipe.

Curb Stops and Brass Fittings: AWWA C 800 as modified in this Section.

1. Inlet End: Flared copper connection or compression-type fitting
2. Valve Body: Straight-through or angled, meter-stop design equipped with following:
  - a. O-ring seal straight plug type.
  - b. Rubber seat ball type.
3. Outlet End: Female, iron-pipe thread or swivel-nut, meter-spud thread on 3-1/4 -inch and flange stops and 2-hole flange on 1-1/2 and 2-inch sizes.
4. Fittings: Provide approved fittings. Use same size open end wrenches and tapping machines as used with respective Mueller fittings.
5. Factory Testing of Brass Fittings:
  - a. Submerge in water for 10 seconds at 85 psi with stop in both closed and open positions.
  - b. Reject fitting that shows air leakage. Contracting Officer may confirm tests locally. Entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

Angle Stops: In accordance with AWWA C 800; ground-key, stop type with bronze lockwing head stop cap; inlet and outlet threads conform to application tables of AWWA C 800; and inlets flared connection or compression.

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1. Outlet for 3/4-inch and 1-inch size: Meter swivel nut with saddle support.
2. Outlet for 1-1/2 -inch through 2-inch size: O-ring sealed meter flange, iron pipe threads.

Fittings: In accordance with AWWA C 800 and following:

1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.
2. Nuts: Smooth cast and has symmetrical hexagonal wrench flats.
3. Flare-Joint Fittings: Smooth cast. Machine seating surfaces for metal-to-metal seal to proper taper or curve, free from pits or protrusions.
4. Thread fittings, of all types, shall have N.P.T. or AWWA threads, and protect male threaded ends in shipment by plastic coating, or approved equal.
5. Compression tube fittings shall have Buna-N beveled gasket.
6. Stamp of manufacturer's name or trademark and of fitting size on body.

### PART 3 EXECUTION

#### 3.1 GENERAL

For service lines and lateral connections larger than those allowed in Pipe Tapping Schedule, branch connections and multiple taps may be used. Space corporation stops minimum of 2 feet apart.

Tapped collars of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location.

Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water lines.

For new meter or when existing meter is in conflict with proposed pavement improvements, locate water meters one foot inside street right-of-way, or when this is not feasible, one foot on curb side of sidewalk. Contact Contracting Officer when major landscaping or trees conflict with service line and meter box location. No additional payment will be made for work on customer side of meter.

New location and installation of existing small meter shall conform to requirements of this Section.

#### 3.2 SERVICE INSTALLATION

Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline.

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Install service lines in open-cut trench in accordance with Section 31 00 00 - EARTHWORK. Install service lines under paved roadways, other paved areas and areas indicated on Drawings in bored hole in accordance with Paragraph 3.01 G.

Lay service lines with minimum of 30 inches of cover as measured from top of curb or, in absence of curbs, from centerline elevation of crowned streets or roads. Provide minimum of 18 inches of cover below flow line of ditches to service lines.

Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Use only full lengths of tubing. Take care not to damage copper tubing when pulling it through hole. Compression-type union is only permitted when span underneath pavement cannot be accomplished with a full standard length of tubing. Use one compression-type union for each full length of tubing.

Maintain service lines free of dirt and foreign matter.

Install service lines so that top of meter will be 4 to 6 inches below finished grade.

Anticipate existing sanitary sewers to have cement stabilized sand backfill to bottom of pavement. Include cost of such crossings in unit price for services.

### 3.3 CURB STOP INSTALLATION

Set curb stops or angle stops at outer end of service line inside of meter box. Secure opening in curb stop to prevent unwanted material from entering. In close quarters, make S-curve in field. Do not flatten tube. In 3/4-inch and 1 -inch services, install meter coupling, swivel-nut, or curb stop ahead of meter. Install straight meter coupling on outlet end of meter.

### 3.4 SEQUENCE OF OPERATIONS

Open trench for proposed service line in accordance with Section 31 00 00 - EARTHWORK.

Install curb stop on meter end of service line.

With curb stop open and prior to connecting service line to meter in slack position, open corporation stop and flush service line thoroughly. Close curb stop, leaving corporation stop in full-open position.

Check service line for apparent leaks. Repair leaks before proceeding.

Schedule inspection with Contracting Officer prior to backfilling. After inspection, backfill in accordance with Section 31 00 00 - EARTHWORK.

Install meter box centered over meter with top of lid flush with finished grade. Meter box: Refer to Section 02 08 50 - Valve Boxes, Meter Boxes, and Meter Vaults.

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| PIPE TAPPING SCHEDULE                   |              |           |           |           |
|---|--------------|-----------|-----------|-----------|
| WATERMAIN<br>TYPE AND DIAMETER          | SERVICE SIZE |           |           |           |
|   | 3/4"         | 1"        | 1-1/2"    | 2"        |
| 4" Cast Iron or<br>Ductile Iron         | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 4" Asbestos Cement                      | WBSS         | WBSS      | DSS, WBSS | DSS, WBSS |
| 4" PVC (AWWA C900)                      | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Cast Iron<br>Or Ductile Iron  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Asbestos<br>Cement            | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" Cast Iron<br>Or Ductile Iron  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 6" and 8" PVC<br>(AWWA C900)            | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" Cast Iron<br>Or Ductile Iron        | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" Asbestos Cement                     | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 12" PVC<br>(AWWA C900)                  | DSS, WBSS    | DSS, WBSS | DSS, WBSS | DSS, WBSS |
| 16" and Up Cast Iron<br>Or Ductile Iron | DWBSS        | DWBSS     | DWBSS     | DWBSS     |
| 16" and Up Asbestos<br>Cement           | DWBSS        | DWBSS     | DWBSS     | DWBSS     |
| 16" and Up PVC<br>(AWWA C900)           | DWBSS        | DWBSS     | DWBSS     | DWBSS     |

DSS - DUAL STRAP SADDLES  
WBSS - WIDE BAND STRAP SADDLES  
DWBSS - DUAL WIDE BAND STRAP SADDLES

END OF SECTION



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SECTION 02 51 30

WET CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

Wet connections for new watermains and service lines to existing watermains.

Related Sections:

1. Section 02 50 10 - DUCTILE PIPE AND FITTINGS
2. Section 02 52 80 - POLYETHYLENE WRAP
3. Section 02 51 20 - WATER TAP AND SERVICE
4. Section 02 52 10 - GATE VALVES

1.2 REFERENCES

AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

1.3 DEFINITIONS

Wet connections consist of isolating sections of pipe to be connected with existing valves, draining isolated sections, and completing connections.

Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of 2-inch service line.

PART 2 PRODUCTS

2.1 MATERIALS

Pipe shall conform to requirements of applicable portions of Sections 02 50 10 through 02 52 80 related to piping materials and to water distribution.

Corporation cocks and saddles shall conform to requirements of Section 02 51 20 - WATER TAP AND SERVICE LINE INSTALLATION.

Valves shall conform to requirements of Section 02 52 10 - GATE VALVES.

Brass fittings shall conform to requirements of AWWA C 800.



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PART 3 EXECUTION

3.1 CONNECTION OPERATIONS

Plan wet connections in manner and at hours with least inconvenience to the public. Notify Contracting Officer at least 72 hours in advance of making connections.

Do not operate valves on water lines in use by American Water. American Water Utility Operations Division will handle, at no cost to Contractor operations involving opening and closing valves for wet connections.

Conduct connection operations when AW Inspector is at job site. Connection work shall progress without interruption until complete once existing water lines have been cut or plugs have been removed for making connections.

3.2 2-INCH WET CONNECTIONS

Tap water line. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing water line. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

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SECTION 02 51 40

DISINFECTION OF WATERMAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

Disinfection of potable watermains.

1.2 REFERENCES

AWWA C 651 - Standard for Disinfecting Watermains.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CONDUCTING DISINFECTION

Promptly disinfect watermains constructed before tests are conducted on watermains and before these watermains are connected to AW water distribution system.

Water for disinfection and flushing will be furnished by AW without charge.

Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations assisted by AW on-site field personnel.

Coordinate chlorination operations through Contracting Officer.

3.2 PREPARATION

Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new watermains prior to connection to AW water distribution system. Normally, each valved section of watermain requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for watermains up to and including 6-inch diameter.

Use fire hydrants as blow-offs to flush newly constructed watermains 8-inch diameters and above. Where fire hydrants are not available on watermains, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.

Slowly fill each section of pipe with water in manner approved by Contracting Officer. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

Backfill excavations immediately after installation of risers or blow-offs.

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Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

If the main is 12 inches diameter or greater, the main should be pigged and then flushed at scouring velocity. See Section 02 53 50 - SANITARY SEWER FORCE MAINS Paragraph 3.04 for pigging procedure.

### 3.3 DISINFECTION BY CONTRACTOR

The following procedure will be used when disinfection by Contractor is required by Contract Documents:

1. Use not less than 100 parts of chlorine per million parts of water.
2. Chlorinating material to watermains in accordance with AWWA C 651.
3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
4. Open and close valves in lines being sterilized several times during contact period.
5. If chemical compound is used for sterilizing agent, place in pipes as directed by Contracting Officer.

### 3.4 BACTERIOLOGICAL TESTING

After disinfection and flushing of water lines, bacteriological tests will be performed by an independent testing laboratory in accordance with Testing Laboratory Services. When test results indicate need for additional disinfection of water lines based upon State Department of Health requirements, Contractor shall assist AW with additional disinfection operations.

### 3.5 COMPLETION

Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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SECTION 02 51 50

HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.1 SECTION INCLUDES

Field hydrostatic testing of newly installed watermain pipelines.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

Disinfect newly constructed watermain pipelines prior to hydrostatic testing.

Hydrostatically test newly installed watermain pipelines after disinfection, when required, and before connecting to the water distribution system.

Water for testing will be charged to Contractor in accordance with local AW billing rates. Prior to hydrostatic testing, obtain a transient meter from the American Water Operations Staff. Deposit is required for transient meter.

Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.

Conduct hydrostatic tests in presence of Contracting Officer and AW Project Manager.

3.2 TEST PROCEDURES

Furnish, install, and operate connections, pump, meter and recording pressure gauges necessary for hydrostatic testing.

Allow watermain pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water.

For small diameter pipelines, expel air and apply minimum test pressure of 150 psi. For large diameter watermain (8" or greater), expel air and apply minimum test pressure of 200 psi.

Begin test by 9:00 a.m. unless otherwise approved by Contracting Officer. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.

Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

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Provide pipe sizes, lengths tested and amount of water required to bring the pressure in the pipe back to the initial pressure prior to the test with results of the leakage tests.

### 3.3 ALLOWABLE LEAKAGE FOR WATERLINES

Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.

For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Contracting Officer and AW Project Manager for leakage during pressure test may be used to fulfill requirements of this section.

### 3.4 CORRECTION FOR FAILED TESTS

Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

Contracting Officer may require failed lines to be disinfected after repair and prior to retesting. Conduct subsequent disinfection operations in accordance with requirements of Section 02 51 40 - Disinfection of Water Lines. Pay for water required for additional disinfection and retesting.

Repeat test until satisfactory results are obtained.

### 3.5 COMPLETION

Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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## SECTION 02 51 60

## CUT, PLUG AND ABANDONMENT OF WATERMAINS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Cut, plug and abandonment of watermains.

Related Sections:

1. Section 32 13 14 - CONCRETE PAVEMENTS FOR SMALL PROJECTS
2. Section 31 00 00 - EARTHWORK
3. Section 32 12 16 - HOT MIX ASPHALT (HMA) FOR ROADS

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit product data for proposed plugs and clamps for approval; G

## PART 2 PRODUCTS

## 2.1 MATERIALS

Concrete for reaction blocks: Conforming to requirements of Section 32 13 14 - CONCRETE PAVEMENTS FOR SMALL PROJECTS.

Plugs and clamps: Applicable for type of pipe to be plugged.

## PART 3 EXECUTION

## 3.1 APPLICATION

Do not begin cut, plug and abandonment operations until replacement watermain has been constructed, disinfected, and tested, and service lines have been transferred to replacement watermain.

Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.

Main to be abandoned shall not be valved off and shall not be cut or plugged other than at supply watermain or as shown on Drawings.

After watermain to be abandoned has been cut and plugged, check for other sources feeding abandoned watermain. When sources are found, notify Contracting Officer immediately. Cut and plug abandoned watermain at point of other feed as directed by Contracting Officer.

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Plug or cap ends or openings in abandoned watermain in manner approved by Contracting Officer.

Remove and dispose of surface identifications such as valve boxes and fire hydrants. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.

Backfill excavations in accordance with Section 31 00 00 - EARTHWORK.

Repair street surfaces in accordance with Section 32 12 16 - HOT-MIX ASPHALT (HMA) FOR ROADS or 32 13 14 - CONCRETE PAVEMENTS FOR SMALL PROJECTS, and the Contract Drawings.

END OF SECTION

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SECTION 02 52 00

FIRE HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

Fire hydrants.

Adjustment of fire hydrants and gate valves.

Related Sections:

1. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS
2. SECTION 02 50 60 - POLYVINYL Chloride Pipe

1.2 REFERENCES

AWWA C 502 - Standard for Dry Barrel Fire Hydrants (Latest Edition).

AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

SSPC SP2 - Hand Tool Cleaning

SSPC SP3 - Power Tool Cleaning

SSPC SP10 - Near-White Blast Cleaning

SSPC SP11 - Power Tool Cleaning to Bare Metal

SSPC Paint Spec No.21

SSPC-Paint 21 - White or Colored Silicone Alkyd Paint

SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SSPC-Paint 104 - White or Tinted Alkyd Paint

Federal Standard A-A-2962A - Enamel, Alkyd, Solvent Based Low VOC

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-03 Product Data

Hydrants; G

Submit name of hydrant manufacturer, type of bonnet paint, and engineering control drawing number for hydrant proposed for use.



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## PART 2 PRODUCTS

### 2.1 HYDRANTS

Provide hydrants in conformance with AWWA C 502, Standard for Dry Barrel Fire Hydrants (Latest Edition). Hydrants are approved by AW by issuance of a Certificate of Responsibility. The following hydrants are approved with no substitutions.

| HYDRANT                    | ENGINEERING CONTROL DRAWING - AMERICAN WATER   |
|----------------------------|--|
| Clow - 5 1/4"<br>Medallion | D-20454 Rev. J dated 02/97<br>D-20455 Rev. B dated 06/20/00 and 94-20051 dated<br>10/26/94 |

The Contracting Officer may, at any time prior to or during installation of hydrants, randomly select furnished hydrant for disassembly and laboratory inspection, at Contractor's expense, to verify compliance with Specifications. When a hydrant is found to be non-compliant, replace hydrant at Contractor's expense with a hydrant that complies with the Specifications.

C. Provide lower hydrant barrel fabricated from Ductile Iron Pipe as single piece, connected to upper hydrant barrel by means of joint coupling that will provide three hundred sixty (360) degree rotation of upper barrel.

### 2.2 LEADS

Branches (Leads): Conform to requirements of Section 02 50 10 - Ductile Iron Pipe and Fittings, Section 02 50 60 - Polyvinyl Chloride Pipe.

### 2.3 HYDRANT PAINTING

New hydrants and refurbished hydrants shall be shop coated as specified herein.

Exterior Above Traffic Flange (Including Bolts & Nuts).

1. Surface preparation to be in accordance with SSPC-SP 10 (NACE 2) near white blast cleaned surface.
2. Coat with three coat alkyd/silicone alkyd system with total dry film thickness (DFT) of 6 - 9 mils as follows:
  - a. Prime Coat - Oil modified alkyd primer, to be in general conformance with SSPC Paint Specification No. 25. Total dry film thickness (DFT) 2 - 3 mils.
  - b. Intermediate Coat - Heavy Duty Industrial Alkyd Enamel to be in general conformance with SSPC Paint Specification No. 104, and Federal Standard A-A-2962A. Total dry film thickness (DFT) of 2 -3 mils.

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- c. Finish Coat - Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Total dry film thickness (DFT) to be 2 - 3 mils. Exception - hydrant bonnet shall not be finished shop coated, only intermediate coated. Install color coded finish coating of bonnet in field.
  - d. Bonnet Paint - Field apply finish coat of Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Dry film thickness of 2 - 3 mils. Bonnet colors are to be as specified in Paragraph 3.01 to designate the appropriate size of water supply line.
3. Colors - Primer: Manufacturers standard color. Finish coat of hydrant body: ACRO 555 Crystal Blue or equivalent. Connection caps: Finished coated white. Paint white band of finish coat two inches in width on hydrant body approximately six inches above and parallel to traffic flange. Intermediate coat: Contrasting color to blue finish, such as white.

#### Field Maintenance Painting (Exterior Above Traffic Flange)

1. Surface Preparation to be in accordance with SSPC - SP2, Hand Tool Cleaning, or SSPC - SP3, Power Tool Cleaning, depending on condition of existing paint and extent of corrosion. It is not necessary to remove tightly adhered mill scale, rust, and paint. Mill scale, rust and paint are considered tightly adherent when they cannot be removed with dull putty knife. In some severe cases where it is necessary to remove majority of existing paint, surface should be cleaned in accordance with SSPC -SP11, Power Tool Cleaning to Bare Metal.
2. When surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new hydrants. When surface is cleaned to SSPC - SP2 or SSPC - SP3, coat hydrant with Silicone Alkyd Resin Enamel in general conformance with SSPC Paint Specification No. 21. Total dry film thickness of 3 - 6 mils surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new hydrants.

#### Exterior Below Traffic Flange

1. Surface preparation in accordance with SSPC- SP10 (MACE 2) Near White Blast Cleaned Surface.
2. Primer and intermediate coat: coal tar epoxy in general conformance with SSPC Paint Specification No. 16. Apply two (2) coats with dry film thickness (DFT) of 8 - 10 mils each for total DFT of 16 -20 mils.
3. Finish coat: Water based vinyl acrylic mastic Apply one coat with dry film thickness of 6 - 8 mils. Color of finish coat to be same as finish coat for exterior above traffic flange, i.e., blue. (Acro 555 Crystal Blue, or equivalent.)

#### Interior Surfaces Above and Below Water Line Valve

1. Material used for internal coating of hydrant interior ferrous

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surfaces below water line valve must meet the requirements of local state standards.

2. Coating shall be liquid or powder epoxy system in accordance with AWWA Standard C - 550 (latest revision). Coating may be applied in two or three coats, according to manufacturer's recommendations, for total dry film thickness of 12 -18 mils.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.

Locate nozzle center line minimum 18 inches above finish grade.

Place 12-inch by 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by Contracting Officer) on pumper nozzles of new or relocated fire hydrants installed on new water lines not in service. Remove indicators after new water line is tested and approved by Contracting Officer.

Do not cover drain ports when placing concrete thrust block.

Obtain Contracting Officer's approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Cost adjustments will not be allowed for changes in water line flow line or fire hydrant barrel length caused by obstructions.

Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to nearest American Water Utility Maintenance Quadrant Facility.

Install branches (leads) in accordance with Section 02 51 10 - WATER MAINS.

#### Coating Requirements:

1. Apply coatings in strict accordance with manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.

2. Furnish affidavit of compliance that coatings furnished complies with requirements of this specification and referenced standards, as applicable.

Use following color code for field coating of hydrant bonnet to indicate size of water line supplying hydrant:

| Supply Water Line Diameter (inches) | Bonnet Color |
|-------------------------------------|--------------|
| 6                                   | Yellow       |
| 8                                   | White        |
| 12-20                               | Green        |
| 24 and larger                       | Orange       |

Remove and dispose of unsuitable materials and debris in accordance with requirements of Waste Material Disposal.

END OF SECTION



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SECTION 02 52 10

GATE VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

Gate valves.

Related Sections:

1. Section 31 00 00 - EARTHWORK

1.2 REFERENCES

ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.

ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.

AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.

AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.

AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.

AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-03 Product Data

Valves; G

Submit manufacturer's product data for proposed valves for approval

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#### 1.4 QUALITY CONTROL

Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

### PART 2 PRODUCTS

#### 2.1 VALVES

Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.

If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 16 inches and smaller. When type of valve is indicated, no substitute is allowed.

Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends

Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.

Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.

Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:

1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.

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4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
6. Stem Seals Consist of three O-rings, two above and one below thrust collar with antifriction washer located above thrust collar for operating torque.
7. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
8. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
9. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:

1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with antifriction washer located above thrust collar for operating torque.
6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
7. Discs: Cast iron with bronze disc rings securely penned into machined dovetailed grooves.
8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.



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9. Provide bypass for valves 24 inches and larger.
10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
12. Stuffing Boxes: Located on top of bonnet and outside gear case.

Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.

1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
6. Provide high strength bronze stem and nut.
7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
9. Provide thrust washers to the thrust collar for easy valve operation.

Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside

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screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Earthwork. Conform to applicable provisions of Section 31 00 00 - EARTHWORK.

B. Operation. Do not use valves for throttling without prior approval of manufacturer.

#### 3.2 SETTING VALVES AND VALVE BOXES

Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.

Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.

For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve. Assemble and brace box in vertical position as indicated on Drawings.

#### 3.3 DISINFECTION AND TESTING

Contractor shall disinfect valves and appurtenances as required by Section 02 51 40 - DISINFECTION OF WATER LINES AND TEST as required by Section 02 51 50 - HYDROSTATIC TESTING OF PIPELINES, with Contracting Officer in attendance.

Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

Repair or replace valves which exceed leakage rate.

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3.4 PAINTING OF VALVES

Paint valves in vaults, stations, and above ground with approved paint.

END OF SECTION

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SECTION 02 52 20

BUTTERFLY VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

Butterfly valves.

Related Sections:

1. Section 02 80 50 - VALVE BOXES, METER BOXES AND METER VAULTS
2. Section 31 00 00 - EARTHWORK
3. Section 01 33 00 - SUBMITTAL PROCEDURES
4. Section 02 51 40 - DISINFECTION OF WATERMAINS
5. Section 02 51 50 - HYDROSTATIC TESTING OF PIPELINES

1.2 REFERENCES

ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

AWWA C 504 - Standard for Rubber-Seated Butterfly Valves.

AWWA C 550 - Standard for Protective Interior Coatings for Valves and Hydrants.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES:

SD-02 Product Data

Valves and Actuators; G

Submit manufacturer's product data for proposed valves and actuators for approval.

Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications.

Submit manufacturer's affidavit that butterfly valves were manufactured in the United States, and conform to applicable requirements of AWWA C 504 and that they have been satisfactorily tested in the United States in accordance with AWWA C 504 using test

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pressure of 150 psi in both directions. Submit Proof-of-Design and hydrostatic testing procedure in accordance with AWWA C 504.

Submit manufacturer's affidavit that coating for interior surfaces of valves conform to applicable requirements of AWWA C 550. Submit results of holiday test and thickness measurements of coatings.

Furnish, at time of delivery, affidavit of compliance, as specified in Section 6.3 of AWWA C 504 certifying compliance with applicable portion of AWWA C 504 and modification or supplements herein. Furnish certified drawings and material test records by manufacturer covering items included in Section 4.3 of AWWA C 504, for review. Furnish certified copies of test reports covering items in Sections 4.5.8.5.5, 4.5.8.5.8 and 5.2.1 through 5.2.4.3 of AWWA C 504 for review.

Submit data indicating maximum torque required to open valve, maximum torsional strength of shaft and torque output of actuator.

Provide submittal information on CD-ROM in Adobe portable document format (\*.PDF).

Include number of turns to operate valves to fully open/closed.

#### 1.4 QUALITY CONTROL

Perform valve leakage tests in both directions at 200 psi in factory and field. Hydrostatic field tests of 200 psi shall be made against dished head plug or similar arrangement.

For purposes of interpreting referenced AWWA tests, the following shall apply: Shutoff pressure is 200 psi; cycle consists of rotating disc from fully opened to fully closed position, for valves larger than 72 inches, proof of design shall require 1000 cycles and shall be performed on valve greater than 72 inches of like design and construction. When proof of design tests are performed on valve delivered to job site, replace disc, bushing, shaft and seals with new and unused items, and test and certify as described above.

Hydrostatic Testing by Manufacturer:

1. Hydrostatic testing to be witnessed by Contracting Officer prior to shipment of valves. Provide minimum 4 weeks notice to Contracting Officer to schedule witness testing. When possible, maximize number of valves to be tested during a plant visit, no more than two visits will be allowed per project to witness test valves, unless otherwise approved by Contracting Officer. Contracting Officer will pay expenses for each visit up to total of two visits incurred by Contracting Officer to witness testing of each grouping of valve(s) per project. Expenses for subsequent or extended visits by Contracting Officer for defective valves, improper scheduling or valve failures are to be paid by Contractor. Witness of hydrostatic testing by Contracting Officer will only be in regards to compliance with this specification and will not constitute approval by Contracting Officer nor relieve Contractor of obligations to comply with contract documents.

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2. Document serial number on valve at time of testing and reflect in certified test records furnished to Contracting Officer. Identification plate must be permanently affixed to valve and actuator prior to hydrostatic testing.
3. Hydrostatic testing to conform to AWWA C504 except as modified below:
  - a. Install actuator prior to hydrostatic testing. Test actuator to verify actual number of turns match manufacturer's published number of turns. Verify valve stops are in correct positions.
  - b. Fully open and close valve prior to performing shell test and prior to each leakage test.
  - c. Perform shell test first.
  - d. When tested with water, adequately dry seat and disc.
  - e. When tested with air, fill top of valve with water to aid in viewing possible leakage.
  - f. Pressure Gauges: Calibrated within past 12 months; 0-500 psi range in increments of 5 psi, present calibration certificates prior to hydrostatic testing.
  - g. If seat adjustment is required during hydrostatic testing, perform valve leakage test again in both directions. Once seat adjustment is made, fully open and fully close valve three (3) times, and repeat leakage test.
4. Field Testing
  - a. When valve arrives at the job site, Contractor is to operate valve fully open and closed twice in presence of Contracting Officer. Document number of turns to open and close each time.
  - b. Install operator nut plum.
  - c. After valve is installed, repeat the operation test and document number of turns in presence of Contracting Officer.
  - d. Manufacturer's representative must be present to witness the operation test again at the substantial walk thru. Verify valve operates fully open/closed twice at the appropriate number of turns.

## PART 2 PRODUCTS

### 2.1 VALVES AND ACTUATORS

Butterfly Valves and Actuators: Provide approved butterfly valves and actuators. Conform to AWWA C 504, except as modified or supplemented herein.

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If type of valve is not indicated on Drawings, use butterfly valves for line valve sizes 24-inch and larger. When type of valve is specified on Drawings, no substitute will be allowed, unless otherwise approved by Contracting Officer.

Butterfly valves shall be short-body, flanged design and installed at locations as shown on Drawings.

Direct-bury valves and valves in subsurface vaults shall open clockwise. Above-ground and plant valves shall open counterclockwise.

## 2.2 VALVE CONSTRUCTION

Valves: AWWA C 504, Class 150B. Body: Cast iron, ASTM A 126, Class B.

Flanges: ASME B 16.1, Class 125 lb.

Discs for Butterfly Valves: Either cast iron or ductile iron. Valves greater than 54 in diameter must utilize flow through disc.

Seats: Buna-N or neoprene, and may be applied to disc or body. Seats shall be mechanically secured and may not rely solely on adhesive properties of epoxy or similar bonding agent to attach seat to body. Seats on disc shall be mechanically retained by stainless steel (18-8) retaining ring held in place by stainless steel (18-8) cap screws that pass through rubber seat for added retention. When seat is on disc, seat shall be retained in position by shoulders located on both disc and stainless-steel retaining ring. Mating surfaces for seats: Type 304 or 316, stainless steel and secured to disc by mechanical means. Sprayed-on or plated mating surfaces will not be allowed. Seat must be replaceable in field for valves greater than 30 inches in diameter. Valves with segmented retaining rings will not be accepted.

Coat interior wetted ferrous surfaces of valve, including disc, with epoxy suitable for potable water conditions. Epoxy, surface preparation, and epoxy application: In accordance with AWWA C 550 and coating manufacturer's recommendations. Provide three coats of two-component, high-build epoxy with minimum dry film thickness of 12 mils. Provide approved epoxy coating. Coatings shall be holiday tested and measured for thickness.

Valve shaft and keys: 24 inches in diameter and greater valves require a minimum of two (2) taper pins used for attaching valve shaft to valve disc, use of torque plug for purposes of attaching valve shaft to valve disc is not permitted: Type 316 stainless steel. Shaft Bearings: Stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with proven record of preventing Teflon flow under load) in accordance with AWWA C 504. Sinter stainless steel bearing material. Design valve shaft to withstand 3 times amount of torque necessary to open valve.

Packing: Self-adjusting and wear compensating, full or split ring V-type, and replaceable without removing actuator assembly.

Retaining Hardware for Seats: Type 304 or 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats shall be held securely with lock tight, or other approved method, to prevent loosening by vibration or cavitation effects.

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Valve disc shall seat in position at 90 degrees to pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Install valves with valve shafts horizontal and convex side of disc facing anticipated direction of flow, except where shown otherwise on Drawings.

For valves utilizing retaining rings, tighten bolts to a uniform torque. Measure torque prior to testing valve.

### 2.3 VALVE BOXES

Provide Standard Type "A" valve boxes conforming to requirements of Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS.

## PART 3 EXECUTION

### 3.1 EARTHWORK

Conform to applicable provisions of Section 31 00 00 - EARTHWORK.

### 3.2 SETTING VALVES AND VALVE BOXES

Prior to Hydrostatic testing of watermain and valve:

1. Test valve by opening and closing valve at a minimum of two times to verify valve seats properly.
2. Verify number of turns from fully open to fully closed position is same as identified in manufacturer's submittal.
3. Adjust valve as required if number of turns do not match.
4. Remove foreign matter from within valves.

Install valves where shown on Drawings or as located by Contracting Officer. Use valve boxes for 16 inch and 24 inch valves. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet.

Avoid disturbing or overstressing valve body when installing valves. Perform field adjustment of valves under pressure to ensure shutoff occurs in number of rotations as described in valves operation and maintenance manual.

Attach two four (4) foot lengths of pipe to each side of valve prior to installation in line.

Submit certification that large diameter valve was installed, adjusted, and exercised in accordance with manufacturer's instructions. Manufacturer's certification shall state that all performance characteristics of large diameter valves, as installed, have been met. Adjustments made to valve, for any reason, must be made by manufacturer's representative.

### 3.3 DISINFECTION AND TESTING



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Contractor shall perform disinfection of valves and appurtenances as required by Section 02 51 40 - DISINFECTION OF WATERMAINS AND TEST as required by Section 02 51 50 - HYDROSTATIC TESTING OF PIPELINES in attendance of Contracting Officer. Do not use valves for throttling without prior approval of manufacturer.

#### 3.4 COATING OF PIPING

Coat valves located in vaults, stations, and above ground using approved paint. Minimum of two (2) coats shall be applied with minimum of three (3) mil thickness. Apply coating in accordance with manufacturer's recommendations.

END OF SECTION

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## SECTION 02 52 50

## TAPPING SLEEVES AND VALVES

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Tapping sleeves and valves for connections to existing water system.

Related Sections:

1. Section 01 33 00 - SUBMITTAL PROCEDURES
2. Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS
3. Section 02 52 80 - POLYETHYLENE WRAP

## 1.2 REFERENCES

ASTM A 240 - Standard Specification for Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

ASTM A 194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High-Temperature Service

AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.

AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.

AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in.

AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-07 Certificates

Materials; G

Submit results of tapping sleeves NPT test opening

Submit manufacturer's affidavit as required in Section 02 52 10 - Gate Valves

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#### 1.4 DELIVERY, STORAGE AND HANDLING

Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### Tapping Sleeves:

1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
2. Branch Outlet of Tapping Sleeve:
  - a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
  - b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Use cast iron split sleeve where fire service from 6-inch watermain is approved.

Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:

1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
8. Provide approved steel tapping sleeves
9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.
10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.

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Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:

1. Flange: ASTM A 240 Stainless Steel, Type 304, ANSI 150 pound drilling.
2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
4. Body: ASTM A 240 Stainless Steel, Type 304.
5. Bolts: ASTM A 193 Stainless Steel, Type 304.
6. Nuts: ASTM A 194 Stainless Steel, Type 304
7. Branch Outlet: Heavy Stainless Steel Pipe
8. Provide approved stainless steel tapping sleeves.
9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.

Tapping Valves: Meet requirements of Section 02 52 10 - GATE VALVES with following exceptions:

1. Inlet Flanges:
  - a. AWWA C 110; Class 125.
  - b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.

Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS.

### PART 3 EXECUTION

#### 3.1 APPLICATION

Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.

Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.

Hydrostatically test installed tapping sleeve to 150 psi for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

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When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.

Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

### 3.2 INSTALLATION

Verify outside diameter of pipe to be tapped prior to ordering sleeve.

Tighten bolts in proper sequence so that undue stress is not placed on pipe.

Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.

Make tap with sharp, shell cutter:

1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.

Withdraw coupon and flush cuttings from newly- made tap.

Wrap:

1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Section 02 52 80 - POLYETHYLENE WRAP.
2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.

Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).

Request inspection of installation prior to backfilling.

Backfill in accordance with Section 31 00 00 - EARTHWORK.

END OF SECTION

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## SECTION 02 52 60

## WATER METERS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Water meters, sub-meters, and fire service meters.

Related Sections:

1. Section 02 51 20 - WATER TAP AND SERVICE LINE INSTALLATION
2. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS
3. Section 02 50 60 - POLYVINYL CHLORIDE PIPE
4. Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS

## 1.2 REFERENCES

ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

AWWA C 510 - Standard for Double Check Valve Backflow - Prevention Assembly.

AWWA C 700 - Standard for Cold-Water Meters - Displacement Type.

AWWA C 701 - Standard for Cold-Water Meters - Turbine Type for Customer Service.

AWWA C 702 - Standard for Cold-Water Meters - Compound Type.

AWWA C 703 - Standard for Cold-Water Meters - Fire Service Type.

AWWA Manual M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES:

SD-07 Certificates

Water Meters; G

Submit written certification of calibration and test results.

Submit manufacturer's certification that water meters meet applicable requirements of this Specification Section.

Submit accuracy registration test certification from manufacturer for each 3-inch through 10 inch diameter meter.

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#### 1.4 QUALITY CONTROL

Submit manufacturer's warranty against defects in materials and workmanship for one (1) year from date of Substantial Completion.

Provide vendor's unconditional guarantee that performance of each meter meets applicable AWWA standards and AWWA Manual M6 as follows:

1. Displacement type: 10 years from installation or register registration shown below, whichever comes first.

| Size<br>(inch) | Registration<br>(million gallons) |
|----------------|-----------------------------------|
| 5/8, 3/4       | 1.5                               |
| 1              | 2.5                               |
| 1-1/2          | 5.0                               |
| 2              | 10.5                              |

2. Turbine type: 1 year from date of installation.
3. Compound type: 1 year from date of installation.
4. Fire service type: 1 year from date of installation, Operations of hermetically sealed register, 5/8-inch to 2-inch diameter, shall be unconditionally guaranteed for 15 years.

Provide manufacturer's unconditional guarantee for each sealed register against leakage, fogging, discoloration and stoppage for 15 years from date of Installation.

Vendor may replace meters that become defective within guarantee period with meters that comply with this Specification. Defective meters will be returned to the vendor at vendor's expense. Meters repaired or replaced under this guarantee must meet accuracy limits for new meters upon receipt and accuracy limits for remaining period of initial guarantee.

#### 1.5 EASEMENT REQUIREMENTS

Install 2-inch and smaller water meters and shut-off valves (stop boxes at right-of-way line when possible. Otherwise, install within 5 foot by 5 foot water meter easement.

Except for 1-inch fire service compound water meters, install 3-inch and larger water meters within minimum of 10 foot by 20 foot water meter easement.

Install 10-inch fire service proportional or compound water meters within minimum of 10-foot by 25-foot water meter easement.

Locate water meter easements contiguous with public right-of-way unless approved by Contracting Officer. Provide minimum fifteen-foot wide access easement when not contiguous with public right-of-way.

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PART 2 PRODUCTS

2.1 WATER METERS

Provide meters of type and size as indicated on Drawings, unless otherwise indicated.

Provide bolted split casings. Main casings of meters and external fasteners: Copper alloy with minimum 75 percent copper for 5/8 inch to 2 inches, bronze or cast iron, hot-dipped galvanized or epoxy coating for 3 inches and larger.

Straightening Vanes: Non-corrosive material compatible with case material.

Intermediate gear train shall not come into contact with water and shall operate in suitable lubricant.

Registers: Automatic Meter Reading (AMR) type that provides pulse, contact closure, piezo switch or encoder generated output signal, compatible with AWS radio and telephone AMR systems. Provide minimum 12-foot wire when permanently connected to register. Lens: impact resistant. Register box: tamper resistant by means of tamper screw or plug: Register: permanently sealed, straight-reading, center-sweep test hand, magnetic driven, U.S. gallons. Digits: 6, black in color, with lowest registering 3 digits (below 1,000-gallon registration) having contrasting digit and background color. Register capacity of meters: 9.99 million gallons for 5/8 inch to 2 inches and 999.999 million gallons for 3 inches and larger.

Connections: 5/8 inch to 1 inch: threads at each end; 1-1/2 to 2 inches: 2-bolt oval flanges each end; 3 inches and larger: flange at each end.

Stamp manufacturer's meter serial number on outer case. Stamp manufacturer's meter serial number on outside of register lid when provided. Manufacturer's serial numbers shall be individual and not duplicated.

Water Meters:

1. Provide approved meters equipped with AMR type register to connect to American Water AMR system. Water Meters less than 1 1/2" in size shall be: Neptune Model T10' (ProRead Gallon 6 wheel plastic bottom) with Neptune Model R900v2 - pit style MIU c/w 6-ft of antenna wire) with no substitutions.

Water Meter to be supplied with a 'McDonald' Cast Iron Yoke as shown on standard detail drawings for locations where directed by Contracting Officer.

2. Provide approved meters equipped with AMR type register to connect to American Water AMR system. Water Meters 1 1/2" and greater shall be Neptune HP Turbine meters with 'Neptune Model R900i - pit style MIU c/w 6-ft of antenna wire with no substitutions.



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Water meter to be supplied with a 'McDonald' meter setter as shown on standard detail drawings for locations where directed by Contracting Officer.

Manufacturing Quality Control shall permit successful interchangeability from one meter to another of same size including registers, measuring chambers and units, discs or pistons as units, change gears, bolts, nuts, and washers without affecting accuracy of new meter.

For water meter vaults provide:

1. Water Meter Vault to be: 'Alliance Model 16 AMR Series' as manufactured by 'DFW Plastics INC. Minimum outside dimensions, 25-1/4 " x 19 3/8". 'AMR' - 'Automatic Meter Reader' type lid shall be provided with a horseshoe type opening cover plate for the installation of the antenna for the MIU. Provide meter box extensions as manufactured by 'Alliance' to suit depth of water meter installation.
2. 1/4-inch steel or aluminum with stainless steel hinge pins. Door shall open to 90 degrees and automatically lock in that position.
3. Provide approved meter vault covers.

## 2.2 METER APPLICATIONS

Sizes 5/8-inch to 2-inch Meters: Displacement type (except for constant flow where 2-inch turbine may apply).

Sizes 3-inch and above Meters:

### 1. Turbines:

Lawn sprinkler systems  
Sewer credit/sub-meter

### 2. Compounds:

Motels and hotels  
Schools  
Restaurants  
Office buildings  
Dormitories, nursing homes, department stores, shopping malls,  
and other commercial establishments

Note: Provide fire service type for sizes larger than 6 inches.

3. Fire Service Type: For designated fire protection lines. Provide proportional or compound type fire service meter assembly (AWWA C 703) when customer elects to use combination of potable and fire protection services in lieu of separate domestic meters and fire services.

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## 2.3 MATERIALS

### Cold-Water Meters:

1. Displacement Type: AWWA C 700; sizes 5/8 inch up to and including 2 inches; oscillating disc or piston of magnetic drive type; bolted split-case design, with either being removable.
2. Turbine Type: AWWA C 701; Class II; sizes 3 inches through 10 inches; flanged; straight-through measuring chamber; rotor construction: polypropylene or similar non rubber material with specific gravity of approximately 1.0, equipped with near frictionless replaceable bearings in turbine working against rotor shaft positioned thrust bearing. Transient/Fire Hydrant Meter Inlet: Female fitting for attachment to hose nozzle with National Standard Fire hose thread. Outlet: 2-inch nipple with National Pipe Thread. Include restriction plate to limit flow through meter to 400 gpm at 65 psi.
3. Compound Type: AWWA C 702; sizes 2 inches through 6 inches. Measuring chambers: For use in continuous operation; separate units of copper alloy (minimum 84 percent copper) or approved polymer material, inert in corrosive potable water; with centering device for proper positioning. Measuring pistons: Non-pilot type with division plates of rubber covering vulcanized to stainless steel or other approved material of sufficient thickness to provide minimum piston oscillation noise. Measuring discs: Flat or conical type, one piece, mounted on monel or 316 stainless steel spindle. Measuring chamber strainer screen area: Twice area of main case inlet.
4. Fire-Service Type: sizes 4 inches through 10 inches; turbine-type, compound type, proportional type; AWWA C 703, with separate check valve conforming to AWWA C 510. Determine size of fire meter by adding fire flow and domestic flow.

## 2.4 STRAINERS

Displacement Potable Water Meters 5/8 inch through 2 inches: Self-straining by means of annular space between measuring chamber and external case or with strainer screens installed in meter. Provide rigid screens which fit snugly, are easy to remove, with effective straining area at least double that of main case inlet.

Potable Water Meters 2-inch diameter and larger: Equip with separate external strainer with bronze body for diameters less than 8 inches. 8-inch diameter and larger may be cast iron, hot-dipped galvanized or epoxy coating. Strainers: Bolted to inlet side of meter, detachable from meter, easily removable lid. Strainer screen: Made of rounded cast bronze, stainless steel wire, having nominal screen size of 3-1/2 mesh-per-inch (U.S. Series) not less than 45 percent clear area.

Provide separate approved external strainers (when required by meter manufacturer) approved for use in fire service metered connections by Underwriters Laboratories. Bodies: Cast iron or copper alloy. Ends: Flanged in accordance with ASME B 16.1, Class 125. Provide stainless steel basket. Strainers shall be detachable from meter.

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## 2.5 CONNECTIONS AND FITTINGS

Provide pipe for connections in accordance with Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS and Section 02 50 60 - POLYVINYL CHLORIDE PIPE. Use restrained joints and flanged joints only.

Fittings:

1. For meters 2 inches and smaller: Same type of fittings as Outlet End fittings for Curb Stop in accordance with Section 02 51 20 - WATER TAP AND SERVICE LINE INSTALLATION.
2. For meters 3 inches and larger: Restrained ductile iron; push-on bell joints or mechanical joint fittings between water line and meter vault; Class 125 flanged inside meter vaults; cement mortar lined and sealed.

## 2.6 LAYING LENGTHS

Minimum laying lengths for meter and standard strainer shall be as shown on Drawings.

## PART 3 EXECUTION

### 3.1 TAPPING AND METER SERVICE INSTALLATION

Meter Service Line:

1. Use pipe and fittings conforming to requirements of Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS, or Section 02 50 60 - POLYVINYL CHLORIDE PIPE.
2. Limit pulling and deflecting of joints to limits recommended by manufacturer.
3. Make vertical adjustments with offset bends where room will permit. Minimize number of bends.
4. Provide minimum of ten pipe diameters of straight pipe length upstream and downstream of meter vault.

### 3.2 METER FITTING HOOKUP

Support meter piping and meter, level and plumb, during installation. Support meters 3 inches and larger with concrete at minimum of two locations.

Use round flanged fittings inside meter box or vault except for mechanical joint to flange adapter. Provide full-face 1/8-inch black neoprene or red rubber gasket material on flanged joints. Provide bolts and nuts made from approved corrosion-resistant material.

Tighten bolts in proper sequence and to correct torque.

Visually check for leaks under normal operating pressure following installation. Repair or replace leaking components.

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### 3.3 METER BOX AND VAULT INSTALLATION

Conform to requirements of Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS.

Perform adjustment to existing meter in accordance with Section 02 08 50 - VALVE BOXES, METER BOXES, AND METER VAULTS.

### 3.4 TESTING

Accuracy registration tests will be conducted in accordance with latest revision of AWWA standard for type and size of meter.

1. Tests will be run by Contractor on meters prior to installation at manufacturing plant with attendance of Contracting Officer. Meters 2 inches and smaller will be tested at random at Contracting Officer's discretion. All 3 inches and larger meters will be tested.
2. Accuracy of displacement meters during guarantee period shall be as follows:
  - a. Initial period: of 18 months from date of shipment or 12 months from date of installation: 98.5% to 101.5% at standard and minimum flow rates; 98% to 101% at low flow rates.
  - b. Second period: AWWA new meter accuracy as tested below.

| <u>GUARANTEE PERIOD</u> |                         |    |                     | <u>TEST FLOW RATE</u> |
|-------------------------|-------------------------|----|---------------------|-----------------------|
| Meter Size<br>(inches)  | Age of Meter<br>(Years) | Or | Million*<br>Gallons | Minimum Rate<br>(gpm) |
| 5/8                     | >1 to <5                |    | 0.5                 | 1/4                   |
| 1                       | >1 to <5                |    | 1.0                 | 3/4                   |
| 1-1/2                   | >1 to <5                |    | 2.5                 | 1-1/2                 |
| 2                       | >1 to <5                |    | 5.5                 | 2                     |

\* Total registration.

- c. Third period: AWWA new meter accuracy for standard flow rates and AWWA repair meter accuracy for minimum flow rate as tested below.

| <u>GUARANTEE PERIOD</u> |                         |    |                     | <u>TEST FLOW RATE</u> |
|-------------------------|-------------------------|----|---------------------|-----------------------|
| Meter Size<br>(inches)  | Age of Meter<br>(Years) | Or | Million*<br>Gallons | Minimum Rate<br>(gpm) |
| 5/8                     | >5 to <10               |    | 1.5                 | 1/4                   |
| 1                       | >5 to <10               |    | 2.5                 | 3/4                   |
| 1-1/2                   | >5 to <10               |    | 5.0                 | 1-1/2                 |
| 2                       | >5 to <10               |    | 10.0                | 2                     |

3. Minimal acceptable accuracy in percent of low flow registration  
for turbine meters:

| <u>Meter Size</u><br><u>(inches)</u> | <u>Minimum Flow</u><br><u>(gpm)</u> | <u>% Accuracy</u><br><u>Required</u> |
|--------------------------------------|-------------------------------------|--------------------------------------|
| 2                                    | 3                                   | 95                                   |
| 3                                    | 5                                   | 95                                   |
| 4                                    | 15                                  | 95                                   |
| 6                                    | 20                                  | 95                                   |
| 8                                    | 20                                  | 95                                   |
| 10                                   | 30                                  | 95                                   |

END OF SECTION

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## SECTION 02 52 80

## POLYETHYLENE WRAP

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Polyethylene wrap to be used in open-cut construction for cast iron and ductile iron pipe when cathodic protection system is not required by Drawings.

## 1.2 REFERENCE

ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials For a Wire and Cable.

AWWA C 105 - Standard for Polyethylene Encasement for Ductile-Iron Pipe System.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-03 Product Data

Materials; G

Submit product data for proposed film and tape for approval.

## PART 2 PRODUCTS

## 3.3 MATERIALS

Polyethylene Film: Tubular or sheet form without tears, breaks, holidays, or defects; conforming with requirements of AWWA C 105, 2.5 to 3 percent carbon black content, either low- or high-density:

1. Low-density polyethylene film. Low-density polyethylene film shall be manufactured of virgin polyethylene material conforming to following requirements of ASTM D 1248.
  - a. Raw material.
    1. Type 1
    2. Class: C (black).
    3. Grade: E-5.
    4. Flow rate (formerly melt index): 0.4 g/10 minute, maximum.
    5. Dielectric strength: Volume resistivity,  $10^{15}$  ohm-cm, minimum

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- b. Physical properties.
    - 1. Tensile strength: 1,200 psi, minimum.
    - 2. Elongation: 300 percent, minimum.
    - 3. Dielectric strength: 800 V/mil thickness, minimum.
  - c. Thickness: Low-density polyethylene film shall have normal thickness of 0.008 inch. Minus tolerance on thickness is 10 percent of nominal thickness.
2. High-density, cross-laminated polyethylene film. High-density, cross laminated polyethylene film shall be manufactured of virgin polyethylene material conforming to following requirements of ASTM D 1248
- a. Raw material.
    - 1. Type: III.
    - 2. Class: C (black)
    - 3. Grade: P33.
    - 4. Flow rate (formerly melt index): 0.4 to 0.5g/10 minute, maximum.
    - 5. Dielectric strength: Volume resistivity,  $10^{15}$  ohm-cm, minimum.
  - b. Physical properties.
    - 1. Tensile strength: 5000 psi, minimum.
    - 2. Elongation: 100 percent, minimum.
    - 3. Dielectric strength: 800 V/mil thickness, minimum.
  - c. Thickness: Film shall have nominal thickness of 0.004 inch. Minus tolerance of thickness is 10 percent of nominal thickness.

Polyethylene Tape: Provide 3-inch-wide, plastic-backed, adhesive tape; Paleocene No. 900, Scotchwrap No. 50, or approved equal.

## PART 3 EXECUTION

### 3.1 PREPARATION

Remove lumps of clay, mud, and cinders from pipe surface prior to installation of polyethylene encasement. Prevent soil or embedment material from becoming trapped between pipe and polyethylene.

Fit polyethylene film to contour of pipe to affect snug, but not tight fit; encase with minimum space between polyethylene and pipe. Allow sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to polyethylene due to backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.

For installations below water table or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.

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### 3.2 INSTALLATION

#### Tubular Type (Method A):

1. Cut polyethylene tube to length approximately 2 feet longer than pipe section. Slip tube around pipe, centering tube to provide 1-foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears pipe ends.
2. Lower pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene tube.
3. After assembling pipe joint, make overlap of polyethylene tube. Pull bunched polyethylene from preceding length of pipe, slip it over end of adjoining length of pipe, and secure in place. Then slip end of polyethylene from adjoining pipe section over end of first wrap until it overlaps joint at end of preceding length of pipe. Secure overlap in place. Take up slack width at top of pipe to make snug, but not tight, fit along barrel of pipe, securing fold at quarter points.
4. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

#### Tubular Type (Method B):

1. Cut polyethylene tube to length approximately 1 foot shorter than pipe section. Slip tube around pipe, centering it to provide 6 inches of bare pipe at each end. Take up slack width at top of pipe to make snug, but not tight, fit along barrel of pipe, securing fold at quarter points; secure ends.
2. Before making up joint, slip 3-foot length of polyethylene tube over end of preceding pipe section, bunching in accordion-fashion lengthwise. After completing joint, pull 3 foot length of polyethylene over joint, overlapping polyethylene previously placed on each adjacent section of pipe by at least 1 foot; make each end snug and secure.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

#### Sheet Type:

1. Cut polyethylene sheet to length approximately 2 feet longer than pipe section. Center length to provide 1-foot overlap on each adjacent pipe section, bunching sheet until it clears pipe ends. Wrap polyethylene around pipe so that sheet circumferentially overlaps top quadrant of pipe. Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.
2. Lower wrapped pipe into trench and makeup pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene. After completing joint, make overlap and secure ends.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

Pipe-shaped Appurtenances: Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in same manner as pipe.

Odd-shaped Appurtenances: When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces in tube, wrap with flat sheet or split length of polyethylene tube by passing sheet around



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appurtenance and encasing it. Make seams by bringing edges together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.

Openings in Encasement: Create openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making X-shaped cut in polyethylene and temporarily folding back film. After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene, with tape. Service taps may also be made directly through polyethylene, with resulting damaged areas being repaired as specified.

Junctions between Wrapped and Unwrapped Pipe: Where polyethylene-wrapped pipe joins adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet. Secure end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from cast or ductile iron pipe.

### 3.3 REPAIRS

Repair cuts, tears, punctures, or damage to polyethylene with adhesive tape or with short length of polyethylene sheet or cut open tube, wrapped around pipe to cover damaged area, and secured in place.

END OF SECTION

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SECTION 02 53 10

GRAVITY SANITARY SEWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

Gravity sanitary sewers and appurtenances, including stacks and service connections.

Related Sections:

1. Section 32 16 13 - CONCRETE SIDEWALKS AND CURBS AND GUTTERS
2. Section 02 08 20 - PRECAST CONCRETE MANHOLES
3. Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS
4. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS
5. Section 02 50 50 - HIGH DENSITY POLYETHYLENE (HDPE) SOLID AND PROFILE WALL PIPE
6. Section 02 50 60 - POLYVINYL CHLORIDE PIPE
7. Section 02 53 40 - SANITARY SEWER SERVICE STUBS OR RECONNECTIONS
8. Section 31 00 00 - EARTHWORK
9. Section 32 92 19 - SEEDING
10. Section 01 33 00 - SUBMITTAL PROCEDURES

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-08 Manufacturer's Instructions

Execution; G

Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

SD-06 Test Reports

Inspection and Testing; G

Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Contracting Officer.

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### 1.3 QUALITY ASSURANCE

Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02 53 30 - Acceptance Testing for Sanitary Sewers.

Regulatory Requirements.

1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
2. Make notification to Contracting Officer when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
3. Lay gravity sewer lines in straight alignment and grade.

### 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

Inspect pipe and fittings upon arrival of materials at job site.

Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.

Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

## PART 2 PRODUCTS

### 2.1 PIPE

Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.

Unlined reinforced concrete pipe is not acceptable.

### 2.2 PIPE MATERIAL SCHEDULE

Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of following Sections:

1. Section 02 50 10 - DUCTILE IRON PIPE AND FITTINGS.
2. Section 02 50 50 - HIGH DENSITY POLYETHYLENE (HDPE) SOLID AND PROFILE WALL PIPE.
3. Section 02 50 60 - POLYVINYL CHLORIDE PIPE.

Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

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### 2.3 APPURTENANCES

Stacks. Conform to requirements of Section 02 53 40 - Sanitary Sewer Service Stubs or Reconnections.

Service Connections. Conform to requirements of Section 02 53 40 - SANITARY SEWER SERVICE STUBS OR RECONNECTIONS.

Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

### 2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

Bedding and Backfill: Conform to requirements of Section 31 00 00 - EARTHWORK, Section 02 32 00 - UTILITY BACKFILL MATERIALS.

Topsoil: Conform to requirements of Section 31 00 00 - EARTHWORK.

## PART 3 EXECUTION

### 3.1 PREPARATION

Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Traffic Control and Regulation.

Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected.

Perform work in accordance with OSHA standards. Employ trench safety system for excavations over 5 feet deep.

Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Contracting Officer and agency or utility company for repairs or relocations, either temporary or permanent.

Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02 41 00 - Demolition.

Install and operate dewatering and surface water control measures in accordance with contract document requirements.

Do not allow sand, debris or runoff to enter sewer system.

### 3.2 DIVERSION PUMPING

Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Contracting Officer.

Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.

No sewage shall be diverted into area outside of sanitary sewer.

In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Contracting Officer so that required reporting can be made to State

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Environmental Agency and Environmental Protection Agency by Contracting Officer and AW Project Manager.

### 3.3 EXCAVATION

Earthwork. Conform to requirements of Section 31 00 00 - EARTHWORK. Use bedding as indicated on Drawings.

Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Contracting Officer. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.

Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 31 00 00 - EARTHWORK.

### 3.4 PIPE INSTALLATION BY OPEN CUT

Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Contracting Officer.

Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.

Form concentric joint with each section of adjoining pipe so as to prevent offsets.

Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe

Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Contracting Officer.

Keep excavations free of water during construction and until final inspection.

When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.

Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.

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Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

### 3.5 PIPE INSTALLATION OTHER THAN OPEN CUT

For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

### 3.6 INSTALLATION OF APPURTENANCES

Service Connections. Install service connections to conform to requirements of Section 02 53 40 - SANITARY SEWER SERVICE STUBS OR RECONNECTIONS.

Stacks. Construct stacks to conform to requirements of 02 53 40 - SANITARY SEWER SERVICE STUBS OR RECONNECTIONS.

Construct manholes to conform to requirements of Section 02 08 20 - Precast Concrete Manholes as applicable. Install frames, rings, and covers to conform to requirements of Section 02 08 40 - FRAMES, GRATES, RINGS, AND COVERS.

### 3.7 INSPECTION AND TESTING

Visual Inspection: Check pipe alignment in accordance with Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS.

Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS.

Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS.

### 3.8 BACKFILL AND SITE CLEANUP

Backfill and compact soil in accordance with Section 31 00 00 - EARTHWORK.

Backfill trench in specified lifts only after pipe installation is approved by Project Manager.

Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 32 16 13 - CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil as specified in Section 31 00 00 - Earthwork and apply seeding in accordance to requirements of Section 32 92 19 - SEEDING.

### 3.9 POST-INSTALLATION TELEVISION INSPECTION

Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and

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collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.

Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.

Perform television inspection of gravity sanitary sewers as follows:

1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.

Provide video tapes in VHS format, recorded at Standard Play (SP). Two labels are required. Place one label on spine and other on face of each video tape. Permanently label each video tape with following information.

Spine of Tape

|                                       |   |
|---------------------------------------|---|
| Wastewater File No.: _____            | Contractor's Name: _____                    |
| Inspection Type: [    ] Survey [    ] | Pre-Installation [    ] Post-Installation   |
| Tape No.: _____                       | Date Televised: _____ Date Submitted: _____ |
| Basin No: _____                       |   |

Face of Tape

| Manhole No.<br>From | Manhole No. To | Pipe Diameter | Pipe Length | Street |
|---------------------|----------------|---------------|-------------|--------|
| _____               | _____          | _____         | _____       | _____  |
| _____               | _____          | _____         | _____       | _____  |
| _____               | _____          | _____         | _____       | _____  |
| _____               | _____          | _____         | _____       | _____  |
| _____               | _____          | _____         | _____       | _____  |

For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.

Upon completion of video tape reviews by Contracting Officer, Contractor will be notified regarding final acceptance of sewer segment.

END OF SECTION

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## SECTION 02 53 30

## ACCEPTANCE TESTING FOR SANITARY SEWERS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

Acceptance testing of sanitary sewers including:

1. Visual inspection of sewer pipes
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.
4. Leakage testing of manholes.
5. Smoke testing of point repairs.

All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

## 1.2 REFERENCES

ASTM C 828 - Standard Test Method for Low Pressure Air Test of  
Vitrified Clay Pipe Lines.

ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by  
Low-Pressure Air Test Method.

ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl  
Chloride) (PVC) Sewer Pipe and Fittings.

ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile  
Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

ASTM F 1417 - Standard Test Method for Installation Acceptance of  
Plastic Gravity Sewer Lines Using Low Pressure Air.

## 1.3 PERFORMANCE REQUIREMENTS

Gravity flow sanitary sewers are required to have straight alignment  
and uniform grade between manholes.

Flexible pipe, including "semi-rigid" pipe, is required to show no more  
than 5 percent deflection. Test pipe no sooner than 30 days after  
backfilling of line segment but prior to final acceptance using  
standard mandrel to verify that installed pipe is within specified  
deflection tolerances.

Maximum allowable leakage for Infiltration or Exfiltration

1. The total exfiltration, as determined by hydrostatic head test,  
shall not exceed 50 gallons per inch diameter per mile of pipe per  
24 hours at minimum test head of 2 feet above crown of pipe at  
upstream manhole or 2 feet above groundwater elevation, whichever is  
greater.
2. When pipes are installed more than 2 feet below groundwater  
level, use infiltration test in lieu of exfiltration test. Total  
infiltration shall not exceed 50 gallons per inch diameter per mile



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of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.

3. Refer to Table 02 53 30-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.

Perform air testing in accordance with requirements of this Section and the local state environmental agency requirements. Refer to Table 02 53 30-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 02 53 30-3, Minimum Testing Times for Low Pressure Air Test, and Table 02 53 30-4, Vacuum Test Time Table, at end of this Section.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-06 Test Reports

Test Plan; G

Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Contracting Officer. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.

Test Reports: Submit test reports for each test on each segment of sanitary sewer.

#### 1.5 GRAVITY SANITARY SEWER QUALITY ASSURANCE

Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

Provide testing reports and video tape of television inspection as directed by Contracting Officer.

Upon completion of tape reviews by Contracting Officer, Contractor will be notified regarding final acceptance of sewer segment.

#### 1.6 SEQUENCING AND SCHEDULING

Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.

Coordinate testing schedules with Contracting Officer. Perform testing under observation of Contracting Officer.

### PART 2 TEST PLAN

#### 2.1 DEFLECTION MANDREL

Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of

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pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.

Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.

Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02 53 30-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Contracting Officer.

## 2.2 EXFILTRATION TEST

Water Meter: Obtain transient water meter from Contracting Officer furnished by AW for use when water for testing will be taken from AW system. Conform to AW requirements for water meter use.

Test Equipment:

1. Pipe plugs.
2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

## 2.3 INFILTRATION TEST

Test Equipment:

1. Calibrated 90 degree V-notch weir.
2. Pipe plugs.

## 2.4 LOW PRESSURE AIR TEST

Minimum Requirement for Equipment:

1. Control panel
2. Low-pressure air supply connected to control panel.
3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
4. Air hoses from control panel to:
  - a. Air supply.
  - b. Pneumatic plugs.
  - c. Sealed line for pressuring.

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d. Sealed line for monitoring internal pressure.

Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

## 2.5 GROUND WATER DETERMINATION

Equipment: Pipe probe or small diameter casing for ground water elevation determination.

## 2.6 SMOKE TESTING

Equipment:

1. Pneumatic plugs.
2. Smoke generator as supplied by Superior Signal Company, or approved equal.
3. Blowers producing 2500 scfm minimum.

## PART 3 EXECUTION

### 3.1 PREPARATION

Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Control of Ground Water and Surface Water.

### 3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and relay or replace pipe segment.

### 3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.

Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.

Retest repaired or replaced sewer sections.

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### 3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

#### Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.

#### Compensating for Ground Water Pressure:

1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.

#### Exfiltration test:

1. Determine ground water elevation.
2. Plug sewer in downstream manhole.
3. Plug incoming pipes in upstream manhole.
4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02 53 30-1 at end of this Section.

Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.
2. Plug incoming pipes in upstream manhole.
3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
4. Allow water to rise and flow over weir until it stabilizes.

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5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 02 53 30-1 at end of this Section.

Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02 53 30-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
2. For pipe sections less than 36-inch average inside diameter:
  - a. Determine ground water level.
  - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
  - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
  - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 02 53 30-2 at end of this Section.
  - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 02 53 30-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

Retest: Repair and retest any section of pipe which fails to meet requirements.

### 3.5 TEST CRITERIA TABLES

Exfiltration and Infiltration Water Tests: Refer to Table 02 53 30-1, Water Test Allowable Leakage, at end of this Section.

Low Pressure Air Test:

1. Times in Table 02 53 30-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B). If the state where the project is being completed has more stringent times, the local state's requirements will apply.

|        |     |   |
|--------|-----|---|
|        |     | $T = 0.0850 (D) (K) / (Q)$  |
| where: | T = | Time for pressure to drop 1.0 pounds per square inch gauge in seconds |
|        | K = | 0.000419 DL, but not less than 1.0                                    |
|        | D = | Average inside diameter in inches                                     |
|        | L = | Length of line of same pipe size in feet                              |
|        | Q = | Rate of loss, 0.0015 ft <sup>3</sup> /min./sq.ft. internal surface    |

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02 53

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### 30-3, Minimum Testing Times for Low Pressure Air Test.

#### Notes:

1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

### 3.6 LEAKAGE TESTING FOR MANHOLES

After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

#### Vacuum testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 02 53 30-4, Vacuum Test Time Table.
3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

#### Perform hydrostatic exfiltration testing as follows:

1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

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### 3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

Application: Perform smoke test to:

1. Locate points of line failure for point repair.
2. Determine when point repairs are properly made.
3. Determine when service connections have been reconnected to rehabilitated sewer.
4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.

Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to local police and fire departments 24 hours prior to actual smoke testing.

Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.

Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Contracting Officer.
2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.

Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Contracting Officer.

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Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

TABLE 02 53 30-1  
WATER TEST ALLOWABLE LEAKAGE

| DIAMETER OF RISER OR STACK<br>IN INCHES                                      | VOLUME PER INCH OF<br>DEPTH |         | ALLOWANCE LEAKAGE*   |                              |
|--|-----------------------------|---------|--|------------------------------|
|  | INCH                        | GALLONS | PIPE SIZE<br>IN INCHES   | GALLONS/MINUTE<br>PER 100FT. |
| 1  | 0.7854                      | .0034   | 6  | 0.0039                       |
| 2  | 3.1416                      | .0136   | 8  | 0.0053                       |
| 2.5  | 4.9087                      | .0212   | 13   | 0.0066                       |
| 3  | 7.0686                      | .0306   | 12   | 0.0079                       |
| 4  | 12.5664                     | .0306   | 15   | 0.0099                       |
| 5  | 19.6350                     | .0544   | 18   | 0.0118                       |
| 6  | 28.2743                     | .1224   | 21   | 0.0138                       |
| 8  | 50.2655                     | .2176   | 24   | 0.0158                       |
|  |                             |         | 27   | 0.0177                       |
|  |                             |         | 30   | 0.0197                       |
|  |                             |         | 36   | 0.0237                       |
|  |                             |         | 42   | 0.0276                       |
| For other diameters, multiply square of diameters by<br>value of 1" diameter |                             |         | Equivalent to 50 gallons per<br>inch of inside diameter per<br>mile per 24 hours |                              |

\* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain



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TABLE 02 53 30-2  
ACCEPTANCE TESTING FOR SANITARY SEWERS

| TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG |                           |                                       |  |   |           |           |           |           |           |           |           |           |           |           |
|--|---------------------------|---------------------------------------|--|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Pipe Dia<br>m.<br>(in)                                   | Min.<br>Time<br>(min:sec) | Length<br>for<br>min.<br>time<br>(ft) | Time<br>for<br>Longer<br>Length<br>(sec) | Specification Time for Length (L) shown (min:sec) |           |           |           |           |           |           |           |           |           |           |
|  |                           |                                       |  | 100<br>ft   | 150<br>ft | 200<br>ft | 250<br>ft | 300<br>ft | 350<br>ft | 400<br>ft | 450<br>ft | 500<br>ft | 550<br>ft | 600<br>ft |
| 6  | 5:40                      | 398                                   | 0.8548                                   | 5:40  | 5:40      | 5:40      | 5:40      | 5:40      | 5:40      | 5:42      | 6:25      | 7:07      | 7:50      | 8:33      |
| 8  | 7:33                      | 298                                   | 1.5196                                   | 7:33  | 7:33      | 7:33      | 7:33      | 7:36      | 8:52      | 10:08     | 11:24     | 12:40     | 13:56     | 15:12     |
| 10   | 9:27                      | 239                                   | 2.3742                                   | 9:27  | 9:27      | 9:27      | 9:54      | 11:52     | 13:51     | 15:50     | 17:48     | 19:47     | 21:46     | 23:45     |
| 12   | 11:20                     | 199                                   | 3.4190                                   | 11:20   | 11:20     | 11:20     | 14:15     | 17:06     | 19:57     | 22:48     | 25:39     | 28:30     | 31:21     | 34:12     |
| 15   | 14:10                     | 159                                   | 5.3423                                   | 14:10   | 14:10     | 17:48     | 22:16     | 26:44     | 31:12     | 35:40     | 40:08     | 44:36     | 48:54     | 53:22     |
| 18   | 17:00                     | 133                                   | 7.6928                                   | 17:00   | 19:14     | 25:39     | 32:04     | 38:29     | 44:54     | 51:19     | 57:44     | 64:09     | 70:34     | 76:59     |
| 21   | 19:50                     | 114                                   | 10.4708                                  | 19:50   | 26:11     | 34:54     | 43:37     | 52:20     | 61:03     | 69:46     | 78:29     | 87:12     | 95:55     | 104:38    |
| 24   | 22:40                     | 99                                    | 13.6762                                  | 22:40   | 34:11     | 45:33     | 56:55     | 68:17     | 79:39     | 91:01     | 102:23    | 113:45    | 125:07    | 136:29    |
| 27   | 25:30                     | 88                                    | 17.3089                                  | 28:51   | 43:16     | 57:41     | 72:06     | 86:31     | 100:56    | 115:11    | 129:36    | 144:01    | 158:26    | 173:01    |
| 30   | 28:20                     | 80                                    | 21.3690                                  | 35:37   | 53:25     | 71:13     | 89:01     | 106:49    | 124:37    | 142:25    | 160:13    | 178:01    | 195:49    | 213:37    |
| 33   | 31:10                     | 72                                    | 25.8565                                  | 43:06   | 64:38     | 86:11     | 107:44    | 129:17    | 150:50    | 172:23    | 193:55    | 215:28    | 237:01    | 258:34    |

TABLE 02 53 30-3  
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

| PIPE DIAMETER<br>(inches) | MINIMUM<br>TIME<br>(seconds) | LENGTH FOR<br>MINIMUM TIME<br>(feet) | TIME FOR LONGER<br>LENGTH<br>(seconds) |
|---------------------------|------------------------------|--------------------------------------|--|
| 6                         | 340                          | 398                                  | 0.855 (L)                              |
| 8                         | 454                          | 298                                  | 1.520 (L)                              |
| 10                        | 567                          | 239                                  | 2.374 (L)                              |
| 12                        | 680                          | 199                                  | 3.419 (L)                              |
| 15                        | 850                          | 159                                  | 5.342 (L)                              |
| 18                        | 1020                         | 133                                  | 7.693 (L)                              |
| 21                        | 1190                         | 114                                  | 10.471 (L)                             |
| 24                        | 1360                         | 100                                  | 13.676 (L)                             |
| 27                        | 1530                         | 88                                   | 17.309 (L)                             |
| 30                        | 1700                         | 80                                   | 21.369 (L)                             |
| 33                        | 1870                         | 72                                   | 25.856 (L)                             |

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| DEPTH IN FEET   | TIME IN SECONDS BY PIPE DIAMETER |     |     |
|---|----------------------------------|-----|-----|
|   | 48"                              | 60" | 72" |
| 4   | 10                               | 13  | 16  |
| 8   | 20                               | 26  | 32  |
| 12  | 30                               | 39  | 48  |
| 16  | 40                               | 52  | 64  |
| 20  | 50                               | 65  | 80  |
| 24  | 60                               | 78  | 96  |
| *   | 5.0                              | 6.5 | 8.0 |
| *Add T times for each additional 2-foot depth.<br>(The values listed above have been extrapolated from ASTM C 924-85) |                                  |     |     |

TABLE 02 53 30-5  
PIPE VS. MANDREL DIAMETER

| Material and<br>Wall Construction | Nominal<br>Size<br>(Inches) | Average<br>I.D<br>(Inches) | Minimum<br>Mandrel<br>Diameter<br>(Inches) |
|-----------------------------------|-----------------------------|----------------------------|--|
| PVC-Solid (SDR 26) 6              | 6                           | 5.764                      | 5.476                                      |
|                                   | 8                           | 7.715                      | 7.329                                      |
|                                   | 10                          | 9.646                      | 9.162                                      |
| PVC-Solid (SDR 35) 12             | 12                          | 11.737                     | 11.150                                     |
|                                   | 15                          | 14.374                     | 13.655                                     |
|                                   | 18                          | 17.629                     | 16.748                                     |
|                                   | 21                          | 20.783                     | 19.744                                     |
|                                   | 24                          | 23.381                     | 22.120                                     |
|                                   | 27                          | 26.351                     | 25.033                                     |
| PVC-Truss                         | 8                           | 7.750                      | 7.363                                      |
|                                   | 10                          | 9.750                      | 9.263                                      |
|                                   | 12                          | 11.790                     | 11.201                                     |
|                                   | 15                          | 14.770                     | 14.032                                     |
| PVC-Profile (ASTM F 794)          | 12                          | 11.740                     | 11.153                                     |
|                                   | 15                          | 14.370                     | 13.652                                     |
|                                   | 18                          | 17.650                     | 16.768                                     |
|                                   | 21                          | 20.750                     | 19.713                                     |
|                                   | 24                          | 23.500                     | 22.325                                     |
|                                   | 27                          | 26.500                     | 25.175                                     |
|                                   | 30                          | 29.500                     | 28.025                                     |
|                                   | 36                          | 35.500                     | 33.725                                     |
|                                   | 42                          | 41.500                     | 39.425                                     |
| HDPE-Profile                      | 48                          | 47.500                     | 45.125                                     |
|                                   | 18                          | 18.000                     | 17.100                                     |
|                                   | 21                          | 21.000                     | 19.950                                     |
|                                   | 24                          | 24.000                     | 22.800                                     |
|                                   | 27                          | 27.000                     | 25.650                                     |
|                                   | 30                          | 30.000                     | 28.500                                     |
|                                   | 36                          | 36.000                     | 34.200                                     |
|                                   | 42                          | 42.000                     | 39.900                                     |

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|   | Nominal<br>Size<br>(Inches) | Average<br>I.D<br>(Inches) | Minimum<br>Mandrel<br>Diameter<br>(Inches) |
|---|-----------------------------|----------------------------|--|
| <u>Material and<br/>Wall Construction</u> |                             |                            |  |
|   | 48                          | 48.000                     | 45.600                                     |
|   | 54                          | 54.000                     | 51.300                                     |
|   | 60                          | 60.000                     | 57.000                                     |
| <br>Fiberglass                            | 12                          | 12.85                      | 11.822                                     |
| (Class SN 46)                             | 18                          | 18.66                      | 17.727                                     |
|   | 20                          | 20.68                      | 19.646                                     |
|   | 24                          | 24.72                      | 23.484                                     |
|   | 30                          | 30.68                      | 29.146                                     |
|   | 36                          | 36.74                      | 34.903                                     |
|   | 42                          | 42.70                      | 40.565                                     |
|   | 48                          | 48.76                      | 46.322                                     |
|   | 54                          | 54.82                      | 52.079                                     |
|   | 60                          | 60.38                      | 57.361                                     |

END OF SECTION

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SECTION 02 53 40

SANITARY SEWER SERVICE STUBS OR RECONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

Installation of service stubs in sanitary sewers serving areas where sanitary sewer service did not previously exist.

Reconnection of existing service connections along parallel, replacement, or rehabilitated sanitary sewers.

1.2 REFERENCES

ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

ASTM D 3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.3 PERFORMANCE REQUIREMENTS

Accurately locate in field all proposed service stubs along new sanitary sewer main.

Accurately locate in field existing service connections and proposed service stubs along alignment of new parallel or replacement sewer main.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

SD-03 Product Data

Products; G

Submit product data for each pipe product, fitting, coupling and adapter.

SD-11 Closeout Submittals

As-builts; G

Show reconnected services on record drawings. Give exact distance from each service connection to nearest downstream manhole.

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## PART 2 PRODUCTS

### 2.1 PVC SERVICE CONNECTION

As stub outs, use PVC sewer pipe of 4-inch through 10-inch diameter, conforming to ASTM D 1784 and ASTM D 3034, with cell classification of 12454-B. SDR (ratio of diameter to wall thickness) shall be 26 for pipe 10 inches in diameter or less.

PVC pipe shall be gasket jointed with gasket conforming to ASTM D 3212.

Provide service connection pipe in sizes shown on Drawings. For reconnection of existing services, select service connection pipe diameter to match existing service diameter. Reconnections to rehabilitated sanitary sewer mains shall be limited to following maximum service connection diameter:

| Sewer Diameter | Maximum Service Connection Diameter |
|----------------|-------------------------------------|
| 8" or less     | 4"                                  |
| 10" or less    | 6"                                  |

Subject to above limits, provide 6-inch service connection when more than one service discharges into single pipe.

Connect service pipes to parallel or replacement sewer mains with prefabricated, full-bodied tee or wye fittings conforming to specifications for sewer main pipe material as specified in other Sections for sewers up to 18 inches in diameter.

Where sewers are installed using pipe augering or tunneling, or where sewer is greater than 18 inches in diameter, use Fowler "Inserta-Tee" to connect service to sewer main.

### 2.2 PIPE SADDLES

Use pipe saddles only on rehabilitated sanitary sewer mains. Comply with Paragraph 2.01E for new parallel and replacement sanitary sewer mains.

Supply one-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket to accomplish complete seal. Use saddle fabricated to fit outside diameter of connecting pipe. Protruding lip of saddle must be at least 5/8-inch long with grooves or ridges to retain stainless steel band clamps.

Use 1/2-inch stainless steel band clamps for securing saddles to liner pipe.

### 2.3 COUPLINGS AND ADAPTERS

For connections between new PVC pipe stubouts and existing service, 4-, 6-, or 8-inch diameter, use flexible adapter coupling consisting of neoprene gasket and stainless steel shear rings with 1/2-inch stainless steel band clamps:

1. Fernco Pipe Connectors, Inc. Series 1055 with shear ring SR-8

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2. Band Seal by Mission Rubber Co., Inc.

3. Approved equal.

For connections between new PVC pipe stubout and new service, use rubber-gasket adapter coupling:

1. GPK Products, Inc.

2. IPS & Sewer Adapter

3. Approved equal.

## 2.4 STACKS

Provide stacks for service connections wherever crown of sewer is 8 feet or more below finished grade.

Construct stacks of same material as sanitary sewer and as shown on Drawings.

Provide stacks of same nominal diameter at sanitary service line.

## 2.5 PLUGS AND CAPS

Seal upstream end of unconnected sewer service stubs with rubber gasket plugs or caps of same pipe type and size. Provide plugs or caps by GPK Products, Inc., or approved equal.

# PART 3 EXECUTION

## 3.1 PERFORMANCE REQUIREMENTS

Provide minimum of 72 hours notice to customers whose sanitary sewer service will potentially be interrupted.

Accurately field locate service connections, whether in service or not, along rehabilitated sanitary sewer main. For parallel and replacement sewers, service connections may be located as pipe laying progresses from downstream to upstream.

Properly disconnect existing connections from sewer and reconnect to rehabilitated liner, as described in this Section.

Reconnect service connections, including those that go to unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by Contracting Officer.

Complete reconnection of service lines within 24 hours after cured-in-place liner installation and within 72 hours after disconnection for sliplining, parallel, or replacement sanitary sewer mains.

Reconnect services on cured-in-place liner at 12 feet depth or less by excavation method. Contracting Officer reserves right to require service connections by excavation when remote cut service connection damages lines.

Reconnection by excavation method shall include stack and fittings and required pipe length to reconnect service line.

Connect services 8 inches in diameter and larger to sewer by construction of manhole. Refer to appropriate Section on manholes for construction.

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### 3.2 PROTECTION

Provide barricades, warning lights, and signs for excavations created for service connections.

Do not allow sand, debris, or runoff to enter sewer system.

### 3.3 PREPARATION

Determine existing sewer locations and number of existing service connections from closed-circuit television (CCTV) inspection tapes or from field survey. Accurately field locate existing service connections, whether in service or not. Use existing service locations to connect or reconnect service lines or liner.

For rehabilitated sanitary sewer mains, allow liner to normalize to ambient temperature and recover from imposed stretch. For cured-in-place liners, verify that liner is completely cured.

For new parallel and replacement sanitary sewer mains, complete testing and acceptance of downstream sewers as applicable. Provide for compliance with requirements of Paragraph 3.01E.

### 3.4 EXCAVATION AND BACKFILL

Excavate in accordance with Section 31 00 00 - Earthwork.

Perform work in accordance with OSHA standards.

Install and operate necessary ground water and surface water control measures in accordance with requirements of the contract documents.

Determine locations where limited access, buildings or structure preclude use of mechanical excavation equipment. Obtain approval from Contracting Officer for hand excavation.

### 3.5 RECONNECTION BY EXCAVATION METHOD

Remove portion of existing sanitary sewer main or carrier pipe to expose liner pipe. Provide sufficient working space for installing prefabricated pipe saddle.

Carefully cut liner pipe making hole to accept stubout protruding from underside of saddle.

Strap on saddle using stainless steel band on each side of saddle. Tighten bands to produce watertight seal of saddle gasket to liner pipe.

Remove and replace cracked, offset, or leaking service line for up to 5 feet, measured horizontally, from center of new liner.

Make up connection between liner and service line using PVC sewer pipe and approved fittings and couplings.

Test service connections before backfilling.

### 3.6 RECONNECTION BY REMOTE METHOD

Make service reconnections using remote-operated cutting tools on cured-in-place liners at depth greater than 12 feet.

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Employ method and equipment that restore service connection capacity to not less than 90 percent of original capacity.

Immediately open missed connections and repair holes drilled in error using method approved by Contracting Officer.

### 3.7 RECONNECTION ON PARALLEL OR REPLACEMENT SEGMENTS

Install service connections on sewer main.

Remove and replace cracked, offset or leaking service line for up to 5 feet, measured horizontally, from centerline of sanitary sewer main.

Make up connection between main and existing service line using PVC sewer pipe and approved couplings, as shown on Drawings.

Test service connections before backfilling.

Embed service connection and service line as specified for sanitary sewer main as shown on Drawings. Place and compact trench zone backfill in compliance with Section 31 00 00 - EARTHWORK.

### 3.8 INSTALLATION OF NEW SERVICE STUBS

Install service connections on sanitary sewer main for each service connection. Provide length of stub indicated on Drawings. Install plug or cap on upstream end of service stub as needed.

Test service connections before backfilling.

Embed service connection and service line as specified for sanitary sewer main, and as shown on Drawings. Place and compact trench zone backfill in compliance with Section 31 00 00 - EARTHWORK. Install minimum 2-foot length of magnetic locating tape along axis of service stub and 9 inches to 12 inches above crown of pipe, at end of stub.

### 3.9 TESTING

Test service reconnections and service stubs. Follow applicable procedures given in Section 02 53 30 - ACCEPTANCE TESTING FOR SANITARY SEWERS to perform smoke testing to confirm reconnection.

Perform post installation CCTV inspection as specified in the contract documents. Cleaning and Television Inspection to show locations of service connection.

### 3.10 CLEANUP

Backfill excavation as specified in Section 31 00 00 - Earthwork.

Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02 41 00 - DEMOLITION. In unpaved areas, bring surface to grade and slope surrounding excavation. Replace minimum of 4 inches of topsoil and seed according to requirements of Section 32 92 19 - SEEDING.

END OF SECTION





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SECTION 02 57 40

DISINFECTION OF WATERMAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

Disinfection of potable watermains.

1.2 REFERENCES

AWWA C 651 - Standard for Disinfecting Watermains.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CONDUCTING DISINFECTION

Promptly disinfect watermains constructed before tests are conducted on watermains and before these watermains are connected to AW water distribution system.

Water for disinfection and flushing will be furnished by AW without charge.

Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations assisted by AW on-site field personnel.

Coordinate chlorination operations through Contracting Officer.

3.2 PREPARATION

Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new watermains prior to connection to AW water distribution system. Normally, each valved section of watermain requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for watermains up to and including 6-inch diameter.

Use fire hydrants as blow-offs to flush newly constructed watermains 8-inch diameters and above. Where fire hydrants are not available on watermains, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.

Slowly fill each section of pipe with water in manner approved by Contracting Officer. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

Backfill excavations immediately after installation of risers or blow-offs.

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Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

If the main is 12 inches diameter or greater, the main should be pigged and then flushed at scouring velocity.

### 3.3 DISINFECTION BY CONTRACTOR

The following procedure will be used when disinfection by Contractor is

required by Contract Documents:

1. Use not less than 100 parts of chlorine per million parts of water.
2. Chlorinating material to watermains in accordance with AWWA C 651.
3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
4. Open and close valves in lines being sterilized several times during contact period.
5. If chemical compound is used for sterilizing agent, place in pipes as directed by Contracting Officer.

### 3.4 BACTERIOLOGICAL TESTING

After disinfection and flushing of water lines, bacteriological tests will be performed by an independent testing laboratory in accordance with Testing Laboratory Services. When test results indicate need for additional disinfection of water lines based upon State Department of Health requirements, Contractor shall assist AW with additional disinfection operations.

### 3.5 COMPLETION

Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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## SECTION 02 61 13

## EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

04/06

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

|             |   |
|-------------|---|
| ASTM D 1556 | (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method   |
| ASTM D 1557 | (2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.)) |
| ASTM D 2167 | (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method                                    |
| ASTM D 2487 | (2000) Soils for Engineering Purposes (Unified Soil Classification System)  |
| ASTM D 2922 | (2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)                                   |
| ASTM D 5434 | (2003) Field Logging of Subsurface Explorations of Soil and Rock  |

## U.S. ARMY CORPS OF ENGINEERS (USACE)

|            |   |
|------------|---|
| EM 385-1-1 | (2003) Safety -- Safety and Health Requirements |
|------------|---|

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

|             |  |
|-------------|--|
| 29 CFR 1926 | Safety and Health Regulations for Construction       |
| 40 CFR 302  | Designation, Reportable Quantities, and Notification |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

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Surveys; G; RE

Separate cross-sections of each area before and after excavation and after backfilling.

#### SD-03 Product Data

Work Plan; G, RE;

Work Plan within 30 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. The Contractor shall allow 30 calendar days in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

- a. Schedule of activities.
- b. Method of excavation and equipment to be used.
- c. Shoring or side-wall slopes proposed.
- d. Dewatering plan.
- e. Storage methods and locations for liquid and solid contaminated material.
- f. Borrow sources and haul routes.
- g. Decontamination procedures.
- h. Spill contingency plan.

Closure Report; G, RE

6 copies of the Closure Report within 14 calendar days of work completion at the site.

#### SD-06 Test Reports

Backfill; G  
Surveys; G  
Confirmation Sampling and Analysis; G  
Sampling of Stored Material; G  
Sampling Liquid; G  
Compaction; G

Test results.

### 1.3 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Surveys shall also be performed immediately after backfill of each excavation. The Contractor shall provide cross-sections on 25 foot intervals and at break points for all excavated areas. Locations of confirmation samples shall also be surveyed and shown on the drawings.

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Surveys shall be performed in accordance with USCOE Tulsa Standards.

#### 1.4 REGULATORY REQUIREMENTS

##### 1.4.1 Permits and Licenses

The Contractor shall obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

##### 1.4.2 Air Emissions

Air emissions shall be monitored and controlled in accordance with Section 01 56 01 ENVIRONMENTAL PROTECTION.

#### 1.5 DESCRIPTION OF WORK

The work shall consist of excavation and temporary storage of approximately 50 cubic yards of contaminated material. Approximate locations of contaminated material are shown on the drawings. Characterization data on the nature and extent of the contaminated material is shown in the Appendix. Subsurface conditions are shown on the geotechnical borings in Appendix A. The Contractor shall submit a Work Plan as specified in the Submittals paragraph. The Contracting Officer shall be notified within 24 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill material is available onsite and typically is found adjacent to the Stormwater Detention Pond. Ground water is noted on geotechnical borings.

#### 1.6 CHEMICAL TESTING

Required sampling and chemical analysis shall be conducted in accordance with Section Ft. Sill DPW Environmental Requirement.

#### 1.7 SCHEDULING

The Contractor shall notify the Contracting Officer 15 calendar days prior to the start of excavation of contaminated material. The Contractor shall be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

### PART 2 PRODUCTS

#### 2.1 BACKFILL

Backfill material shall be obtained from the location indicated on the drawings. Backfill shall be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for the parameters listed below at a frequency of once per 1000 cubic yards. A minimum of one set of classification tests shall be performed per borrow source. Two backfill sample per borrow source shall also be collected and tested in accordance with Ft. Sill DPW Environmental Requirements.

Backfill shall not be used until borrow source chemical and physical test results have been submitted and approved.

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## 2.2 SPILL RESPONSE MATERIALS

The Contractor shall provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

## PART 3 EXECUTION

### 3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. The Contractor shall take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

### 3.2 CLEARING

Clearing shall be performed to the limits shown on the drawings in accordance with Section 31 11 00 CLEARING AND GRUBBING.

### 3.3 CONTAMINATED MATERIAL REMOVAL

#### 3.3.1 Excavation

Areas of contamination shall be excavated to the depth and extent shown on the drawings and not more than 60 mm beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D 5434.

#### 3.3.2 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

#### 3.3.3 Dewatering

Surface water shall be diverted to prevent entry into the excavation. Dewatering shall be limited to that necessary to assure adequate access, a safe excavation, prevent the spread of contamination, and to ensure that compaction requirements can be met. No dewatering shall be performed without prior approval of the Contracting Officer.

### 3.4 CONFIRMATION SAMPLING AND ANALYSIS

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination. If the excavation appears to be free of contamination, field analysis shall be used to determine the presence of

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contamination using a real time vapor monitoring instrument or immunoassay field kits. Excavation of additional material shall be as directed by the Contracting Officer. After all suspected contaminated material is removed, confirmation samples shall be collected and analyzed for contaminants as required by Ft. Sill DPW Environmental Officer.

Samples shall be collected at a frequency of one per 100 square yards from the bottom and each of the side walls or as directed by the Contracting Officer. A minimum of one sample shall be collected from the bottom and each side wall of the excavation. Based on test results, the Contractor shall propose any additional excavation which may be required to remove material which is contaminated above action levels. Additional excavation shall be subject to approval by the Contracting Officer. Locations of samples shall be marked in the field and documented on the as-built drawings.

### 3.5 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

#### 3.5.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be 25 cubic yards. Stockpiles shall be constructed to include:

- a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs. per 1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane. Pavement shall be used as the liner system. Pavement shall be constructed in accordance with Section 32 16 13.
- b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs. per 1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.
- c. Berms surrounding the stockpile, a minimum of 12 inches in height. Vehicle access points shall also be bermed.
- d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.



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### 3.5.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. The units shall be removed from Ft. Sill. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.

### 3.5.3 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in 55 gallon barrels. Liquid storage containers shall be water-tight and shall be removed from Ft. Sill.

## 3.6 SAMPLING

### 3.6.1 Sampling of Stored Material

Samples of stored material shall be collected at a frequency of once per 25 cubic yards. Samples shall be tested in accordance with Ft. Sill DPW Environmental Office requirements.

Stored material with contaminant levels that exceed the action levels shall be treated offsite. Analyses for contaminated material to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government and subject to approval by the Contracting Officer.

### 3.6.2 Sampling Liquid

Liquid collected from excavations shall be sampled at a frequency of once for every 500 gallons of liquid collected. Samples shall be tested in accordance with Ft. Sill DPW Environmental Office requirements.

Liquid with contaminant levels that exceed action levels shall be treated offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

### 3.6.3 Sampling Beneath Storage Units

Samples from beneath each storage unit shall be collected prior to construction of and after removal of the storage unit. Samples shall be collected at a frequency of one per each 500 square yards from a depth interval of 0 to 0.5 feet and shall be tested in accordance with Ft. Sill DPW Environmental requirements.

Based on test results, soil which has become contaminated above action levels shall be removed at no additional cost to the Government.

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Contaminated material which is removed from beneath the storage unit shall be handled in accordance with paragraph Sampling of Stored Material. As directed by the Contracting Officer and at no additional cost to the Government, additional sampling and testing shall be performed to verify areas of contamination found beneath stockpiles have been cleaned up to below action levels.

### 3.7 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, the Contractor shall follow the pre-established procedures as described in the RCRA Contingency Plan or Base Wide Contingency Plan for immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

### 3.8 BACKFILLING

#### 3.8.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

#### 3.8.2 Compaction

Approved backfill shall be placed in lifts with a maximum loose thickness of 8 inches. Soil shall be compacted to 95 percent of ASTM D 1557 maximum dry density. Density tests shall be performed at a frequency of once per 5000 square feet per lift. A minimum of three density tests shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If ASTM D 2922 is used, a minimum of one in ten tests shall be checked using ASTM D 1556 or ASTM D 2167. Test results from ASTM D 1556 or ASTM D 2167 shall govern if there is a discrepancy with the ASTM D 2922 test results.

### 3.9 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

### 3.10 CLOSURE REPORT

Six copies of a Closure Report shall be prepared and submitted within 14 calendar days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general Contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

- a. A cover letter signed by a responsible company official and Professional Engineer registered in the State of Oklahoma

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certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents and regulatory requirements.

b. A narrative report including, but not limited to, the following:

(1) site conditions, ground water elevation, and cleanup criteria;

(2) excavation logs;

(3) field screening readings;

(4) quantity of materials removed from each area of contamination;

(5) quantity of water/product removed during dewatering;

(6) sampling locations and sampling methods;

(7) sample collection data such as time of collection and method of preservation;

(8) sample chain-of-custody forms; and

(9) source of backfill.

c. Copies of all chemical and physical test results.

d. Copies of all manifests and land disposal restriction notifications.

e. Copies of all certifications of final disposal signed by the responsible disposal facility official.

f. Waste profile sheets.

g. Scale drawings showing limits of each excavation, limits of contamination, known underground utilities within 50 feet of excavation, sample locations, and sample identification numbers. On-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.

h. Progress Photographs. Color photographs shall be used to document progress of the work. A minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, activities at each work location shall be photographically recorded weekly. Photographs shall be a minimum of 3 x 5 inches and shall include:

(1) Soil removal and sampling.

(2) Dewatering operations.

(3) Unanticipated events such as spills and the discovery of additional contaminated material.

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(4) Contaminated material/water storage, handling, treatment, and transport.

(5) Site or task-specific employee respiratory and personal protection.

(6) Fill placement and grading.

(7) Post-construction photographs. After completion of work at each site, the Contractor shall take a minimum of four views of each excavation site.

A digital version of all photos shown in the report shall be included with the Closure Report. Photographs shall be a minimum of 3 inches by 5 inches and shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

|                 |                      |
|-----------------|----------------------|
| Project Name:   | Direction of View:   |
| Location:       | Date/Time:           |
| Photograph No.: | Description of View: |

-- End of Section --



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SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

IATA DGR (2004) Dangerous Goods Regulations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

|            |   |
|------------|---|
| 40 CFR 261 | Identification and Listing of Hazardous Waste   |
| 40 CFR 262 | Standards Applicable to Generators of Hazardous Waste   |
| 40 CFR 263 | Standards Applicable to Transporters of Hazardous Waste   |
| 40 CFR 264 | Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities                     |
| 40 CFR 265 | Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities      |
| 40 CFR 266 | Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities |
| 40 CFR 268 | Land Disposal Restrictions  |
| 40 CFR 270 | EPA Administered Permit Programs: The Hazardous Waste Permit Program  |
| 40 CFR 300 | National Oil and Hazardous Substances Pollution Contingency Plan  |
| 40 CFR 302 | Designation, Reportable Quantities, and Notification  |
| 40 CFR 61  | National Emission Standards for Hazardous Air Pollutants  |
| 40 CFR 761 | Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions            |

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|            |  |
|------------|--|
| 49 CFR 107 | Hazardous Materials Program Procedures   |
| 49 CFR 172 | Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements |
| 49 CFR 173 | Shippers - General Requirements for Shipments and Packagings   |
| 49 CFR 178 | Specifications for Packagings  |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-03 Product Data

On-site Hazardous Waste Management; G;

Prior to start of work, a plan detailing the manner in which hazardous wastes shall be managed. Written documentation of weekly hazardous waste inspections shall be submitted on a monthly basis.

Notices of Non-Compliance and Notices of Violation

Notices of non-compliance or notices of violation, as specified.

### SD-06 Test Reports

Recordkeeping; G;

Information necessary to file state annual or EPA biennial reports for all hazardous waste transported, treated, stored, or disposed of under this contract. The Contractor shall not forward these data directly to the regulatory agency but to the Contracting Officer at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or state regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location.

Spill Response

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds a reporting threshold, the Contractor shall follow the pre-established procedures for immediate reporting to the Contracting Officer.

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#### Exception Reports; G;

In the event that a manifest copy documenting receipt of hazardous waste at the treatment, storage, and disposal facility is not received within 35 days of shipment initiation, the Contractor shall prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation. In the event that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, the Contractor shall prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation.

#### Packaging Notifications

In accordance with 49 CFR 178.2(c), the Contractor shall acquire the appropriate notifications from the package manufacturers or any other persons certifying compliance with the packaging provisions and provide these to the Government.

#### SD-07 Certificates

##### Certification

Copies of the current certificates of registration required by 49 CFR 107, Subpart G issued to the Contractor and/or Subcontractors or written statements certifying exemption from these requirements.

##### Security Plan

Pre-transportation security plan, as specified.

##### Transportation and Disposal Coordinator; G;

Transportation and Disposal Coordinator qualifications including proof of at least one year specialized experience in management and transportation of hazardous wastes; proof of current Department of Transportation Hazardous Materials Training Certification; and, where applicable, proof of IATA DGR.

##### Training; G;

Documentation that employees preparing or transporting hazardous materials have been trained, tested, and certified per 49 CFR 172, Subpart H, including general security awareness requirements and where applicable, site-specific security plan requirements.

##### EPA Off-Site Policy

A letter certifying that EPA considers the facilities to be used for all off-site disposal to be acceptable in accordance with the Off-Site policy in 40 CFR 300, Section .440. This certification shall be provided for wastes from Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 et seq., sites as well as from Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq., responses. See Attachment A, sample certification, at the end of this section.



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#### Certificates of Disposal

Certificates documenting the ultimate disposal, destruction or placement of hazardous wastes, polychlorinated biphenyls (PCBs), and/or asbestos within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

#### Shipping Documents and Packagings Certification; G;

All transportation related shipping documents to the Contracting Officer, including draft bill of lading for hazardous materials for review a minimum of 14 days prior to anticipated pickup. Packaging assurances shall be furnished prior to transporting hazardous material; shall be furnished when shipments are originated; and "receipt copies" of hazardous waste manifests, PCB manifests and asbestos waste shipment records at the designated disposal facility shall be furnished not later than 35 days after acceptance of the shipment.

#### Waste Minimization; G

Written certification that waste minimization efforts have been undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

### 1.3 QUALIFICATIONS

#### 1.3.1 Transportation and Disposal Coordinator

The Contractor shall designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters and shall have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of waste profiles, hazardous waste manifests, asbestos waste shipment records, PCB manifests, bill of lading, exception and discrepancy reports; and all other environmental documentation. The TDC shall have, at a minimum, one year of specialized experience in the management and transportation of hazardous waste and have been Department of Transportation certified under 49 CFR 172, Subpart H.

#### 1.3.2 Training

The Contractor's hazardous materials employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01 10 00 SAFETY and 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. The Contractor's employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, shall be trained, tested, and certified in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Where shipment of hazardous materials by air may be occurring, such as for sample shipments, the Contractor's hazardous material employees shall also be trained on IATA DGR. Contractor employees making determinations that shipments do not constitute DOT regulated

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hazardous materials shall also be trained, tested, and certified in accordance with 49 CFR 172, Subpart H.

#### 1.3.3 Certification

The Contractor and/or Subcontractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G.

#### 1.4 LAWS AND REGULATIONS REQUIREMENTS

Work shall meet or exceed the minimum requirements established by Federal, state, and local laws and regulations which are applicable. These requirements are amended frequently and the Contractor shall be responsible for complying with amendments as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, the Contractor shall notify the Contracting Officer immediately.

#### 1.5 DEFINITIONS

- a. Hazardous Material. A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.
- b. Hazardous Waste. A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

The Contractor shall provide all of the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards and USACE EP 415-1-266. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

##### 2.1.1 Packagings

The Contractor shall provide bulk and non-bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101,

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and shall be compatible with the material to be packaged as required by 40 CFR 262. The Contractor shall also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section .314. In addition, packaging notifications will be provided to the Government per 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

#### 2.1.2 Markings

The Contractor shall provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section .32 (for hazardous waste), 40 CFR 61, Section .149(d) (for asbestos). Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

#### 2.1.3 Labeling

The Contractor shall provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

#### 2.1.4 Placards

For each off-site shipment of hazardous material/waste, the Contractor shall provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

#### 2.1.5 Spill Response Materials

The Contractor shall provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

### 2.2 EQUIPMENT AND TOOLS

The Contractor shall provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

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## PART 3 EXECUTION

### 3.1 ON-SITE HAZARDOUS WASTE MANAGEMENT

These paragraphs apply to Government owned waste only. Contractors are prohibited by 10 U.S.C. 2692 from storing Contractor owned waste on site for any length of time. The Contractor shall be responsible for ensuring compliance with all Federal, state, and local hazardous waste laws and regulations and shall verify those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. The Contractor shall identify hazardous wastes using criteria set forth in 40 CFR 261 or all applicable state and local laws, regulations, and ordinances. When accumulating hazardous waste on-site, the Contractor shall comply with generator requirements in 40 CFR 262 and any applicable state or local law or regulations. On-site accumulation times shall be restricted to applicable time frames referenced in 40 CFR 262, Section .34 and any applicable state or local law or regulation. Accumulation start dates shall commence when waste is first generated (i.e. containerized or otherwise collected for discard). The Contractor shall only use containers in good condition and compatible with the waste to be stored. The Contractor shall be responsible for ensuring containers are closed except when adding or removing waste. The Contractor shall be responsible for immediately marking all hazardous waste containers with the words "hazardous waste" and other information required by 40 CFR 262, Section .32 and any applicable state or local law or regulation as soon as the waste is containerized. An additional marking shall be placed on containers of "unknowns" designating the date sampled, and the suspected hazard. The Contractor shall be responsible for inspecting containers for signs of deterioration and shall be responsible for responding to any spills or leaks. The Contractor shall inspect all hazardous waste areas weekly and shall provide written documentation of the inspection. Inspection logs shall contain date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken.

#### 3.1.1 Hazardous Waste Classification

The Contractor, in consultation with the Contracting Officer, shall identify all waste codes applicable to each hazardous waste stream based on requirements in 40 CFR 261 or any applicable state or local law or regulation. The Contractor shall also identify all applicable treatment standards in 40 CFR 268 and state land disposal restrictions and shall make a determination as to whether or not the waste meets or exceeds the standards. Waste profiles, analyses, classification and treatment standards information shall be submitted to Contracting Officer for review and approval.

#### 3.1.2 Management Plan

The Contractor shall prepare a plan detailing the manner in which hazardous wastes will be managed and describing the types and volumes of hazardous wastes anticipated to be managed as well as the management practices to be utilized. The plan shall identify the method to be used to ensure accurate piece counts and/or weights of shipments; shall identify waste minimization methods; shall propose facilities to be utilized for treatment, storage, and/or disposal; shall identify areas on-site where hazardous wastes are to be handled; shall identify whether transfer facilities are to be utilized; and if so, how the wastes will be tracked to ultimate disposal.

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### 3.2 OFF-SITE HAZARDOUS WASTE MANAGEMENT

The Contractor shall use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Off-site treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used. The Contractor shall submit Notices of Non-Compliance and Notices of Violation by a Federal, state, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. The Contractor shall immediately provide copies of such notices to the Contracting Officer. The Contractor shall also furnish all relevant documents regarding the incident and any information requested by the Contracting Officer, and shall coordinate its response to the notice with the Contracting Officer or his designated representative prior to submission to the notifying authority. The Contractor shall also furnish a copy to the Contracting Officer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

#### 3.2.1 Treatment, Storage, and/or Disposal Facility and Transporter

The Contractor shall provide the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information shall be contained in the Hazardous Waste Management Plan and shall be approved by the Contracting Officer prior to waste disposal.

#### 3.2.2 Status of the Facility

Facilities receiving hazardous waste must be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or must be permitted by a state authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, the Contractor shall contact the EPA Regional Off-site Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Off-Site policy and furnish this information to the Contracting Officer.

#### 3.2.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material off-site, the Contractor's TDC shall provide written certification to the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. The Contractor's TDC shall also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

#### 3.2.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities shall either certify to the Government that a Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of

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hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. The Contractor shall use manifests for transporting hazardous wastes as required by 40 CFR 263 or any applicable state or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. The Contractor shall prepare hazardous waste manifests for each shipment of hazardous waste shipped off-site. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable state or local law or regulation. Manifests and waste profiles shall be submitted to Contracting Officer for review and approval. The Contractor shall prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable state or local law or regulation for each shipment of hazardous waste. Notifications shall be submitted with the manifest to the Contracting Officer for review and approval.

### 3.2.5 Treatment and Disposal of Hazardous Wastes

The hazardous waste shall be transported to an approved hazardous waste treatment, storage, or disposal facility within 90 days of the accumulation start date on each container. The Contractor shall ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. The Contractor shall ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. The Contractor shall propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the Contracting Officer. The Contractor shall submit Certificates of Disposal as specified in the Submittals paragraph.

### 3.3 HAZARDOUS MATERIALS MANAGEMENT

The Contractor, in consultation with the Contracting Officer, shall evaluate, prior to shipment of any material off-site, whether the material is regulated as a hazardous waste in addition to being regulated as a hazardous material; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etc., as described below.

#### 3.3.1 Identification of Proper Shipping Names

The Contractor shall use 49 CFR 172, Section .101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped off-site. Proper shipping names shall be submitted to the Contracting Officer in the form of draft shipping documents for review and approval.

#### 3.3.2 Packaging, Labeling, and Marking

The Contractor shall package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. The Contractor shall mark each container of hazardous waste of 110 gallons or less with the following:

"HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal.

If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.

Generator's name \_\_\_\_\_  
Manifest Document Number \_\_\_\_\_".

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### 3.3.3 Shipping Documents

The Contractor shall ensure that each shipment of hazardous material sent off-site is accompanied by properly completed shipping documents. This includes shipments of samples that may potentially meet the definition of a Department of Transportation regulated hazardous material.

#### 3.3.3.1 PCB Waste Shipment Documents

The Contractor shall prepare hazardous waste manifests for each shipment of PCB waste shipped off-site. Manifests shall be completed using instructions in 40 CFR 761, Sections .207 and .208 and all other applicable requirements. Documents shall be submitted to Contracting Officer for review and approval.

#### 3.3.3.2 Asbestos Waste Shipment Documents

The Contractor shall prepare waste shipment records as required by 40 CFR 61 for shipments of asbestos. Waste shipment records shall be submitted to the Contracting Officer for review and approval. Waste shipment records shall be signed by the Contractor.

#### 3.3.3.3 Other Hazardous Material Shipment Documents

The Contractor shall prepare a bill of lading for each shipment of hazardous material which is not accompanied by a hazardous waste manifest or asbestos waste shipment record which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, and any applicable state or local law or regulation, and shall be submitted to the Contracting Officer for review and approval. For laboratory samples and treatability study samples, the Contractor shall prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261, Section .4(d) and (e) and any applicable state or local law or regulation. Bill of lading requiring shipper's certifications shall be signed by the Contractor.

### 3.4 OBTAINING EPA ID NUMBERS

The Contractor shall complete EPA Form 8700-12, Notification of Hazardous Waste Activity, and submit to the Contracting Officer for review and approval. The Contractor shall allow a minimum of 30 days for processing the application and assigning the EPA ID number. Shipment shall be made not earlier than one week after receipt of the EPA ID number.

### 3.5 SPECIAL REQUIREMENTS FOR ASBESTOS WASTES

If work involves asbestos containing wastes, the Contractor shall manage these wastes in accordance with Ft. Sill DPW Environmental requirements.

### 3.6 WASTE MINIMIZATION

The Contractor shall minimize the generation of hazardous waste to the maximum extent practicable. The Contractor shall take all necessary precautions to avoid mixing clean and contaminated wastes. The Contractor shall identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals.

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### 3.7 RECORDKEEPING

The Contractor shall be responsible for maintaining adequate records to support information provided to the Contracting Officer regarding exception reports, annual reports, and biennial reports. The Contractor shall be responsible for maintaining asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract. The Contractor shall be responsible for maintaining bill of lading for a minimum of 375 days from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract.

### 3.8 SPILL RESPONSE

The Contractor shall respond to any spills of hazardous material or hazardous waste which are in the custody or care of the Contractor, pursuant to this contract. Any direction from the Contracting Officer concerning a spill or release shall not be considered a change under the contract. The Contractor shall comply with all applicable requirements of Federal, state, or local laws or regulations regarding any spill incident.

### 3.9 EMERGENCY CONTACTS

The Contractor shall be responsible for complying with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, the Contractor shall provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. The phone must be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. The Contractor shall ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. The Contractor shall designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

- a. The name of the emergency coordinator.
- b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.
- c. The telephone number of the local fire department.
- d. The location of fire extinguishers and spill control materials.



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Attachment A  
SAMPLE OFF-SITE POLICY CERTIFICATION MEMO

Project/Contract #: \_\_\_\_\_  
Waste Stream: \_\_\_\_\_  
Primary TSD Facility, EPA ID # and Location: \_\_\_\_\_  
Alter. TSD Facility, EPA ID # and Location: \_\_\_\_\_

| EPA Region | Contact        |
|------------|----------------|
| I          | (617) 918-1752 |
| II         | (212) 637-4130 |
| III        | (214) 814-5267 |
| IV         | (404) 562-8591 |
| V          | (312) 353-8207 |
| VI         | (214) 665-2282 |
| VII        | (913) 551-7154 |
| VIII       | (303) 312-6419 |
| IX         | (415) 972-3304 |
| X          | (206) 553-2859 |

EPA representative contacted: \_\_\_\_\_  
EPA representative phone number: \_\_\_\_\_  
Date contacted: \_\_\_\_\_

Comment: \_\_\_\_\_  
The above EPA representative was contacted on \_\_\_\_\_. As of that date  
the above sites were considered acceptable in accordance with the Off-Site  
Policy in 40 CFR 300.440.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Phone number: \_\_\_\_\_

-- End of Section --

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SECTION 03 20 01.00 10

CONCRETE REINFORCEMENT  
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318 (2008; Errata 2008) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A 615/A 615M (2008b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A 706/A 706M (2008a) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 767/A 767M (2005) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

ASTM A 775/A 775M (2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A 82/A 82M (2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

ASTM A 934/A 934M (2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2001; 27Ed) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

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## Reinforcement

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

### SD-07 Certificates

#### Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

### 1.3 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

## PART 2 PRODUCTS

### 2.1 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82/A 82M. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M, ASTM A 775/A 775M or ASTM A 934/A 934M as appropriate.

### 2.2 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

### 2.3 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

## PART 3 EXECUTION

### 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or

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at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

#### 3.1.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

#### 3.1.1.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

-- End of Section --



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SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE  
04/08

PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance with ACI MCP SET Parts 2 and 3.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI MCP SET (2009) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 615/A 615M (2008b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C 1064/C 1064M (2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C 1260 (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C 143/C 143M (2008) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C 150 (2007) Standard Specification for Portland Cement

ASTM C 1567 (2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

ASTM C 171 (2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C 172 (2008) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C 173/C 173M (2008a) Standard Test Method for Air

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Content of Freshly Mixed Concrete by the  
Volumetric Method

|                   |  |
|-------------------|--|
| ASTM C 231        | (2008c) Standard Test Method for Air<br>Content of Freshly Mixed Concrete by the<br>Pressure Method            |
| ASTM C 260        | (2006) Standard Specification for<br>Air-Entraining Admixtures for Concrete                                    |
| ASTM C 309        | (2007) Standard Specification for Liquid<br>Membrane-Forming Compounds for Curing<br>Concrete                  |
| ASTM C 31/C 31M   | (2008b) Standard Practice for Making and<br>Curing Concrete Test Specimens in the Field                        |
| ASTM C 33/C 33M   | (2008) Standard Specification for Concrete<br>Aggregates   |
| ASTM C 39/C 39M   | (2005e1e2) Standard Test Method for<br>Compressive Strength of Cylindrical<br>Concrete Specimens               |
| ASTM C 494/C 494M | (2008a) Standard Specification for<br>Chemical Admixtures for Concrete   |
| ASTM C 618        | (2008a) Standard Specification for Coal<br>Fly Ash and Raw or Calcined Natural<br>Pozzolan for Use in Concrete |
| ASTM C 685/C 685M | (2007) Concrete Made by Volumetric<br>Batching and Continuous Mixing   |
| ASTM C 94/C 94M   | (2009) Standard Specification for<br>Ready-Mixed Concrete  |
| ASTM C 989        | (2009) Standard Specification for Ground<br>Granulated Blast-Furnace Slag for Use in<br>Concrete and Mortars   |
| ASTM D 75         | (2003) Standard Practice for Sampling<br>Aggregates  |

U.S. ARMY CORPS OF ENGINEERS (USACE)

|               |   |
|---------------|---|
| COE CRD-C 400 | (1963) Requirements for Water for Use in<br>Mixing or Curing Concrete |
|---------------|---|

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

|            |  |
|------------|--|
| 40 CFR 247 | Comprehensive Procurement Guideline for<br>Products Containing Recovered Materials |
|------------|--|

1.3 SYSTEM DESCRIPTION

The Government retains the option to sample and test aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Government in

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procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with ASTM D 75. Sample concrete in accordance with ASTM C 172. Determine slump and air content in accordance with ASTM C 143/C 143M and ASTM C 231, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C 31/C 31M. Test compression test specimens in accordance with ASTM C 39/C 39M. Take samples for strength tests not less than once each shift in which concrete is produced. Provide a minimum of three specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

#### 1.3.1 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength,  $f'_c$ , and no individual acceptance test result falls below  $f'_c$  by more than 500 psi.

#### 1.3.2 Construction Tolerances

Apply a Class "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in Part 4 of ACI MCP SET.

#### 1.3.3 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength  $f'_c$  shall be 4,000 psi at 28 days. The maximum nominal size coarse aggregate is 1 inch, in accordance with ACI MCP SET Part 3. The air content shall be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water cement ratio is 0.45.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-03 Product Data

- Air-Entraining Admixture
- Water-Reducing or Retarding Admixture
- Curing Materials
- Reinforcing Steel



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Manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the above materials.

#### Batching and Mixing Equipment

Manufacturer's data for batching and mixing equipment which demonstrates compliance with the applicable specifications.

#### Conveying and Placing Concrete

Methods and equipment for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement.

#### Formwork

Formwork design prior to the first concrete placement.

Mix Design Data  
Fly Ash

### SD-06 Test Reports

#### Aggregates

Test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications.

#### Concrete Mixture Proportions

The mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete. Applicable test reports to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

Compressive Strength Testing  
Slump

### SD-07 Certificates

Cementitious Materials  
CPG for recycled materials or appropriate Waiver Form

Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with 40 CFR 247.

#### Aggregates

Certificates of compliance stating that the material(s) meet the quality and grading requirements of the specifications under which it is furnished.

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## 1.5 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement Steel Reinforcement Accessories on installation drawings and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

### 1.5.1 Regulatory Requirements

The state statutory and regulatory requirements form a part of this specification to the extent referenced. Submit CPG for recycled materials or appropriate Waiver Form.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Cementitious Materials

Provide cementitious materials that conform to the appropriate specifications listed:

##### 2.1.1.1 Portland Cement

ASTM C 150, Type I/II.

##### 2.1.1.2 Pozzolan

Provide pozzolan that conforms to ASTM C 618, Class C or F, including requirements of Tables 1A and 2A.

#### 2.1.2 Aggregates

Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C 33/C 33M Class Designations 4M or better and be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C 1260. Perform evaluation of fine and coarse aggregates separately and in combination, matching the proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. If the test data indicates an expansion of 0.10 (0.08) percent or greater, reject the aggregate(s) or perform additional testing using ASTM C 1260 and ASTM C 1567. Perform the additional testing using ASTM C 1260 and ASTM C 1567 using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. Use GGBF slag in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 25 to 40 percent of the total cementitious material by mass.

#### 2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

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#### 2.1.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C 260.

#### 2.1.3.2 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C 494/C 494M, Type A, B, or D.

#### 2.1.4 Water

Use fresh, clean, potable water for mixing and curing, free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

#### 2.1.5 Reinforcing Steel

Provide reinforcing bars conforming to the requirements of ASTM A 615/A 615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A 185/A 185M. Details of reinforcement not shown shall be in accordance with ACI MCP SET Part 3, Chapters 7 and 12.

#### 2.1.6 Formwork

The design and engineering of the formwork as well as its construction, will be the responsibility of the Contractor.

#### 2.1.7 Form Coatings

Coat forms, for exposed surfaces, with a nonstaining form oil to be applied shortly before concrete is placed.

#### 2.1.8 Curing Materials

Provide curing materials conforming to the following requirements.

##### 2.1.8.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

##### 2.1.8.2 Membrane-Forming Curing Compound

ASTM C 309, Type 1-D or 2, Class A.

#### 2.2 READY-MIX CONCRETE

a. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP SET Part 2

b. Non-exposed concrete elements: 4000 psi minimum compressive strength.

c. Direct-exposed concrete elements (including air-conditioned rooms): 5000 psi minimum compressive strength as determined in 28 calendar days.

d. Slump: 2 to 4 inch according to ASTM C 143/C 143M and ACI MCP SET Part 1. Concrete slump for drilled shafts shall be as indicated for

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each method of construction.

- i. Dry and uncased excavation: 4 to 6 inches.
- ii. Cased excavation with casing withdrawn: 6 to 8 inches.
- iii. Slurry construction (underwater placement): 7 to 9 inches.

e. Portland Cement conforming to ASTM C 150, Type I/II.

f. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

g. Air-Entraining Admixtures conforming to ASTM C 260. Exterior concrete exposed to freezing needs to be air-entrained 5 to 6 percent by volume. Nonair-entrained interior concrete shall have a total air content of 2 to 4 percent by volume.

h. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

i. Fly Ash used as an admixture shall conform to ASTM C 618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight. Submit documentation in compliance with 40 CFR 247.

j. Ground granulated blast furnace slag used as an admixture shall conform to ASTM C 989, Grade 120 with between 25 to 50 percent maximum cement replacement by weight. Submit documentation in compliance with 40 CFR 247.

## 2.3 STEEL REINFORCEMENT

### 2.3.1 Deformed Steel Bars

Provide steel bars conforming to ASTM A 615/A 615M, Grade .60 ksi ACI MCP SET Parts 2 and 3.

### 2.3.2 Welded Wire Fabric

Provide welded wire fabric conforming to ASTM A 185/A 185M.

## 2.4 FORMS

Forms shall be of wood, steel, or other approved material and conform to ACI MCP SET, Parts 2 and 3.

Provide form release conforming to ACI MCP SET, Part 4.

## 2.5 ACCESSORIES

### 2.5.1 Curing Compound

Provide curing compound conforming to ASTM C 309.

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### PART 3 EXECUTION

#### 3.1 PREPARATION

##### 3.1.1 General

Prepare construction joints to expose coarse aggregate. The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the Government prior to placing.

##### 3.1.2 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

##### 3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges, unless otherwise indicated.

##### 3.1.4 Production of Concrete

###### 3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C 94/C 94M except as otherwise specified.

###### 3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685/C 685M.

#### 3.2 CONVEYING AND PLACING CONCRETE

Perform conveying and placing concrete in conformance with the following requirements.

##### 3.2.1 General

Concrete placement is not permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. Convey concrete from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients.

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Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Deposit concrete as close as possible to its final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be prevented.

### 3.2.2 Consolidation

Consolidate each layer of concrete by internal vibrating equipment. Systematically accomplish internal vibration by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

### 3.2.3 Cold-Weather Requirements

No concrete is to be mixed or placed when the ambient temperature is below 36 degrees F or if the ambient temperature is below 41 degrees F and falling. Provide suitable covering and other means as approved for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing. Remove and replace concrete damaged by freezing at the expense of the Contractor.

### 3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP SET Part 2, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures taken as quickly as finishing operations will allow.

### 3.2.5 Lifts in Concrete

Deposit concrete in horizontal layers not to exceed 24 inches in thickness. Carry on placement at a rate that prevents the formation of cold joints. Place slabs in one lift.

## 3.3 FORM REMOVAL

Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

## 3.4 FINISHING

### 3.4.1 General

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

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### 3.4.2 Finishing Formed Surfaces

Remove all fins and loose materials , and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured is the same as adjacent concrete.

### 3.4.3 Finishing Unformed Surfaces

Float finish all unformed surfaces, that are not to be covered by additional concrete or backfill, to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish as determined by a 10 foot straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

#### 3.4.3.1 Float Finish

Provide float finished surfaces, screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete supports a person's weight without deep imprint, complete floating. Floating shall embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

### 3.5 CURING AND PROTECTION

Beginning immediately after placement, and continuing for at least 7 days, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms by one of the following methods:

- a. Continuous sprinkling or ponding.
- b. Application of absorptive mats or fabrics kept continuously wet.
- c. Application of sand kept continuously wet.
- d. Application of impervious sheet material conforming to ASTM C 171.

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e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

### 3.6 TESTS AND INSPECTIONS

#### 3.6.1 General

The individuals who sample and test concrete, as required in this specification, must have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

#### 3.6.2 Inspection Details and Frequency of Testing

##### 3.6.2.1 Preparations for Placing

Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

##### 3.6.2.2 Air Content

Check air content at least once during each shift that concrete is placed for each class of concrete required. Obtain samples in accordance with ASTM C 172 and tested in accordance with ASTM C 231.

##### 3.6.2.3 Slump

Check slump once during each shift that concrete is produced for each class of concrete required. Obtain samples in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

##### 3.6.2.4 Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

#### 3.6.3 Action Required

##### 3.6.3.1 Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Do not continue placing if any pile is inadequately consolidated.

##### 3.6.3.2 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of



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concrete to forms.

#### 3.6.3.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

#### 3.6.4 Reports

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within 3 days after the end of each weekly reporting period. See Section 01 45 01 USACE QUALITY CONTROL.

### 3.7 FORM WORK

Form work shall conform to ACI MCP SET Parts 2 through 5.

#### 3.7.1 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Chamfer exposed joints and exposed edges. Arrange internal ties so that when the forms are removed, the form ties are not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

#### 3.7.2 Form Coating

Coat forms, for exposed surfaces, with a nonstaining form release coating applied shortly before concrete is placed. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

#### 3.7.3 Removal of Forms

Remove forms carefully to prevent damage to the concrete. Do not remove forms before the expiration of the minimum time indicated below:

|   |           |
|---|-----------|
| Arches, beams and deck-type slabs           | 144 hours |
| Columns and walls (lifts 15 feet and under) | 24 hours  |
| Columns and walls (lifts over 15 feet)      | 48 hours  |

### 3.8 STEEL REINFORCING

#### 3.8.1 General

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

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### 3.8.2 Fabrication

Shop fabricate steel reinforcement in accordance with ACI MCP SET Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP SET Parts 2 and 3.

### 3.8.3 Splicing

Perform splices in accordance with ACI MCP SET Parts 2 and 3.

### 3.8.4 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

### 3.9 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

### 3.10 BILL OF LADING

Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C 94/C 94M.

### 3.11 FIELD TESTING

- a. Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with ASTM C 172.
- b. Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to ASTM C 31/C 31M. Perform Compressive strength testing conforming to ASTM C 39/C 39M.
- c. Test Slump at the site of discharge for each design mix in accordance with ASTM C 143/C 143M.
- d. Test air content for air-entrained concrete in accordance with ASTM C 231. Test concrete using lightweight or test extremely porous aggregates in accordance with ASTM C 173/C 173M.
- e. Determine temperature of concrete at time of placement in accordance with ASTM C 1064/C 1064M.

-- End of Section --



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SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code

IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 56 00 EXTERIOR LIGHTING

Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

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- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

#### 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13.2 kV primary, three phase, four wire, 60 Hz, and 480 volts secondary, three phase, four wire (or 208V, three phase, four wire as determined by Contractor). Final connections to the power distribution system at the existing shall be made by the Contractor as directed by the Contracting Officer.

#### 1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

##### 1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

##### 1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

#### 1.6 QUALITY ASSURANCE

##### 1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

##### 1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar

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circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

#### 1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

### 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### 1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

### 1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

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#### 1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

#### 1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including pad-mounted switches having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.

#### 1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

#### 1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

### PART 2 PRODUCTS

#### 2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

### PART 3 EXECUTION

#### 3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces

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or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

### 3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

### 3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --





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SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2003) Acceptance Testing Specifications

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and

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test instruments used shall be calibrated in accordance with NETA ATS.

- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

#### 1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

#### 1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

### PART 2 PRODUCTS

Not used.

### PART 3 EXECUTION

#### 3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION
- b. Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

#### 3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion

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of acceptance tests and inspections.

### 3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --



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SECTION 26 28 01.00 10

COORDINATED POWER SYSTEM PROTECTION  
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007; INT 2008) National  
Electrical Safety Code

IEEE C37.46 (2000) For High Voltage Expulsion and  
Current-Limiting Type Power Class Fuses  
and Fuse Disconnecting Switches

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (2002) Molded-Case Circuit Breakers,  
Molded Case Switches, and Circuit-Breaker  
Enclosures

NEMA FU 1 (2002; R 2007) Low Voltage Cartridge Fuses

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical  
Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 198M (2003; Rev thru Oct 2007) Mine-Duty Fuses

UL 486E (1994; Rev thru May 2000) Equipment Wiring  
Terminals for Use with Aluminum and/or  
Copper Conductors

UL 489 (2002; Rev thru Jun 2006) Standard for  
Molded-Case Circuit Breakers, Molded-Case  
Switches and Circuit-Breaker Enclosures

UL 877 (1993; Rev thru Nov 1999) Circuit Breakers  
and Circuit-Breaker Enclosures for Use in  
Hazardous (Classified) Locations

1.2 SYSTEM DESCRIPTION

The power system covered by this specification consists of: MV fuses in metal enclosed switches, and miscellaneous LV fuses and circuit breakers.

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### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

##### Equipment

Data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

##### Installation

Procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment.

#### SD-06 Test Reports

##### Field Testing

The proposed test plan, prior to field tests, consisting of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault protection equipment, where used. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

#### SD-07 Certificates

##### Devices and Equipment

Certificates certifying that all devices or equipment meet the requirements of the contract documents.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems.

#### 1.4.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years

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of current product experience in protective devices.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

#### 1.6 PROJECT/SITE CONDITIONS

Devices and equipment furnished under this section shall be suitable for the following site conditions. Seismic details shall be as indicated. See Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND paragraph 1.2.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCT

Provide protective devices and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory utility type use for at least two years prior to bid opening.

#### 2.2 NAMEPLATES

Provide nameplates to identify all protective devices and equipment. Nameplate information shall be in accordance with NEMA AB 1.

#### 2.3 CORROSION PROTECTION

Metallic materials shall be protected against corrosion. Ferrous metal hardware shall be zinc or chrome-plated.

#### 2.4 LOW-VOLTAGE FUSES

##### 2.4.1 General

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as specified. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics requires for effective power system coordination.

##### 2.4.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 and RK5 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class R fuses shall conform to UL 198M.



2.4.2.1 Continuous Current Ratings (600 amperes and smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.4.2.2 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.5 MEDIUM-VOLTAGE AND HIGH-VOLTAGE FUSES

2.5.1 General

Medium-voltage and high-voltage fuses shall be distribution fuse cutouts or power fuses, E-rated, C-rated, or R-rated current-limiting fuses as shown.

2.5.2 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.5.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Continuous-current ratings shall be as shown.

2.5.3.1 Fuse Cutouts

Medium-voltage fuses and cutouts shall be of the loadbreak open type construction rated 15 kV and of the ultra-heavy-duty type. Open-link cutouts are not acceptable. Fuses shall be either indicating or dropout type. Fuse ratings shall be as indicated. Fused cutouts shall be equipped with mounting brackets suitable for the indicated installations.

2.5.3.2 Power Fuses

Current-limiting power fuses shall have ratings in accordance with IEEE C37.46 and as follows:

- a. Nominal voltage.....13.2 kV
- b. Rated maximum voltage.....15.5 kV
- c. Maximum symmetrical interrupting capacity.....50 kA
- d. Rated continuous current.....As shown
- e. BIL.....95 kV

2.5.3.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to IEEE C37.46.

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## 2.6 MOLDED-CASE CIRCUIT BREAKERS

### 2.6.1 General

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers. Circuit breakers and circuit breaker enclosures located in hazardous (classified) areas shall conform to UL 877.

### 2.6.2 Construction

Molded-case circuit breakers shall be assembled as an integral unit in a supporting and enclosing housing of glass reinforced insulating material providing high dielectric strength. Circuit breakers shall be suitable for mounting and operating in any position. Lugs shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

### 2.6.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

### 2.6.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

## 2.7 COORDINATED POWER SYSTEM PROTECTION

Analysis shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. Provide a list of references complete with points of contact, addresses and approval of the Contracting Officer.

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#### 2.7.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the MV fuses at Pole 4-583 to the secondary side of the facility's transformer.

#### 2.7.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Utilize the fault current availability indicated as a basis for fault current studies.

#### 2.7.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

#### 2.7.4 Fault Current Analysis

##### 2.7.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

##### 2.7.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

##### 2.7.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

#### 2.7.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and setting; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be

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provided on log-log graph paper.

#### 2.7.6 Study Report

- a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.
- c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.
- d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.
- e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

#### 3.2 INSTALLATION

Install protective devices in accordance with the manufacturer's published instructions and in accordance with the requirements of NFPA 70 and IEEE C2.

#### 3.3 FIELD TESTING

##### 3.3.1 General

Perform field testing in the presence of the Contracting Officer. Notify the Contracting Officer 14 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results.

##### 3.3.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers,

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and danger signs to protect and warn personnel in the test vicinity.  
Replace any devices or equipment which are damaged due to improper test  
procedures or handling.

### 3.3.3 Molded-Case Circuit Breakers

Circuit breakers shall be visually inspected, operated manually, and  
connections checked for tightness. Current ratings shall be verified and  
adjustable settings incorporated in accordance with the coordination study.

-- End of Section --

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SECTION 26 56 00

EXTERIOR LIGHTING

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO LTS (2001; Am 2002, Am 2003, Am 2006) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C136.21 (2004) Roadway Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaires

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM B 108/B 108M (2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9 (2000; Errata 2004; Errata 2005) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA C136.13 (2004) Roadway Lighting Equipment, Metal Brackets for Wood Poles

NEMA C136.3 (2005) Roadway and Area Lighting

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Equipment Luminaire Attachments

NEMA C78.1381 (1998) Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps

NEMA C78.43 (2007) Standard for Electric Lamps - Single-Ended Metal-Halide Lamps

NEMA C82.4 (2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1029 (1994; Rev thru Dec 2007) Standard for Safety High-Intensity-Discharge Lamp Ballasts

UL 1598 (2008; Rev thru Nov 2008) Luminaires

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.
- b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire drawings; G

Poles; G

SD-03 Product Data

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#### Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

#### Energy Efficiency

Luminaires; G

Lamps; G

Ballasts; G

Lighting contactor; G

Time switch; G

Photocell switch; G

Aluminum poles; G

Brackets

#### SD-05 Design Data

Design Data for luminaires; G

#### SD-06 Test Reports

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

#### SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Drawing Requirements

##### 1.4.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.



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#### 1.4.1.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS, pole deflection, pole class, and other applicable information.

#### 1.4.2 Design Data for Luminaires

- a. Distribution data according to IESNA classification type as defined in IESNA HB-9.
- b. Computerized horizontal illumination levels in footcandles at ground level, taken every 10 feet. Include average maintained footcandle level and maximum and minimum ratio.
- c. Amount of shielding on luminaires.

#### 1.4.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.4.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.4.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.4.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

##### 1.5.1 Aluminum Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied

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pole wrappings until just before installing pole.

## 1.6 SUSTAINABLE DESIGN REQUIREMENTS

### 1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

### 1.6.2 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

## 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

## 1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

## PART 2 PRODUCTS

### 2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

### 2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

#### 2.2.1 Lamps

##### 2.2.1.1 Metal-Halide Lamps

Provide luminaires with tempered glass lens.

- a. Double-ended, 70 watt, conforming to NEMA C78.1381

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b. Single-ended, wattage as indicated, conforming to NEMA C78.43

Fixtures shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

1. 150-399 watts: minimum 41 LER for closed fixture
2. 400-999 watts: minimum 53 LER for closed fixture; minimum 59 for open fixture
3. 1000+ watts: minimum 77 LER for closed fixture

b. Upward efficiency of 1%-10%

1. 150-399 watts: minimum 56 LER for closed fixture
2. 400-999 watts: minimum 62 LER for closed fixture; minimum 64 for open fixture
3. 1000+ watts: minimum 88 LER for open fixture

c. Upward efficiency greater than 20%

1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture
2. 400-999 watts: minimum 65 LER for closed fixture

#### 2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and NEMA C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

- a. Designed to operate on voltage system to which they are connected. Coordinate voltage with central issue facility Design-Build Contractor.
- b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

All fixtures shall have pulse start ballasts.

#### 2.3 LIGHTING CONTACTOR

Lighting contractor shall be provided by Central Issue Facility design-build.

#### 2.4 TIME SWITCH

Time switch shall be provided by Central Issue Facility design-build.

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## 2.5 PHOTOCCELL SWITCH

Photocell shall be provided by Central Issue Facility design-build.

## 2.6 POLES

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

### 2.6.1 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel. Aluminum poles and brackets for lighting shall have a dark anodized bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

## 2.7 BRACKETS AND SUPPORTS

NEMA C136.3, NEMA C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted parking lot lights shall correctly position luminaire no lower than mounting height indicated. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

## 2.8 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

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## 2.9 EQUIPMENT IDENTIFICATION

### 2.9.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 2.9.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only \_\_\_\_\_":

- a. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- b. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- c. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

## 2.10 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

#### 3.1.1 Aluminum Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

#### 3.1.2 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified

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in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.  
Where copper grounding conductor is connected to a metal other than copper,  
provide specially treated or lined connectors suitable for this purpose.

### 3.1.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces  
or to meet the indicated or specified safety criteria. Painting shall be  
as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM,  
UNDERGROUND paragraph 2.3.3.

### 3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly  
installed, connected, and adjusted. Conduct an operating test to show that  
the equipment operates in accordance with the requirements of this section.

-- End of Section --



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SECTION 31 00 00

EARTHWORK  
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

- |              |  |
|--------------|--|
| AASHTO T 180 | (2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop |
| AASHTO T 224 | (2001) Correction for Coarse Particles in the Soil Compaction Test   |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- |           |   |
|-----------|---|
| AWWA C600 | (2005) Installation of Ductile-Iron Water Mains and Their Appurtenances |
|-----------|---|

ASTM INTERNATIONAL (ASTM)

- |             |   |
|-------------|---|
| ASTM C 136  | (2005) Sieve Analysis of Fine and Coarse Aggregates   |
| ASTM D 1140 | (2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve   |
| ASTM D 1556 | (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method   |
| ASTM D 1557 | (2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.)) |
| ASTM D 1883 | (1999) CBR (California Bearing Ratio) of Laboratory-Compacted Soils   |
| ASTM D 2167 | (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method                                    |
| ASTM D 2487 | (2000) Soils for Engineering Purposes (Unified Soil Classification System)  |
| ASTM D 2922 | (2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)                                   |
| ASTM D 2937 | (2000e1) Density of Soil in Place by the  |



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Drive-Cylinder Method

|             |   |
|-------------|---|
| ASTM D 3017 | (2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 422  | (1963; R 2002) Particle-Size Analysis of Soils                                    |
| ASTM D 4318 | (2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils                 |

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD CONSTRUCTION  
SPECIFICATIONS

|             |                           |
|-------------|---------------------------|
| Section 202 | Excavation and Embankment |
| Section 203 | Test Rolling              |
| Section 205 | Salvaging Topsoil         |
| Section 209 | Machine Grading           |
| Section 310 | Subgrade                  |
| Section 601 | Riprap                    |
| Section 703 | Granular Pipe Embankment  |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

|                  |  |
|------------------|--|
| EPA 600/4-79/020 | (1983) Methods for Chemical Analysis of Water and Wastes   |
| EPA SW-846.3-3   | (1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods |

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GC, SC, SP, CL. Materials classified as ML, CL-ML, CH, MH are not satisfactory for embankments to support pavements or buildings but are suitable for use in constructing the earth berm for the Stormwater Detention Ponds. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements which comprise stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

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#### 1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

#### 1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

#### 1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas or excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

#### 1.2.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

#### 1.2.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

#### 1.2.8 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

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### 1.2.9 Select Granular Material

#### 1.2.9.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, SP, by ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

#### 1.2.9.2 California Bearing Ratio Values

Bearing Ratio: At 0.1 inch penetration, provide a minimum bearing ratio of 5 percent at 95 percent ASTM D 1557 maximum density as determined in accordance with ASTM D 1883 for a laboratory soaking period of not less than 4 days. Provide 8 percent maximum expansion. Conform the combined material to the following sieve analysis:

| <u>Sieve Size</u> | <u>Percent Passing by Weight</u> |
|-------------------|----------------------------------|
| 2 1/2 inch        | 100                              |
| No. 4             | 40 - 85                          |
| No. 10            | 20 - 80                          |
| No. 40            | 10 - 60                          |
| No. 200           | 5 - 25                           |

#### 1.2.10 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

#### 1.2.11 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 12 when tested in accordance with ASTM D 4318.

#### 1.2.12 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of 0.5 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G

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Dewatering Work Plan; G

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G  
Opening of any Excavation or Borrow Pit  
Shoulder Construction

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing  
Borrow Site Testing

Within 24 hours of conclusion of physical tests, 6 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

1.4 SUBSURFACE DATA

Subsurface soil boring logs are appended to the SPECIAL CONTRACT REQUIREMENTS. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at Ft. Sill DPW or Tulsa District C.O.E. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.5.1 BLASTING

Blasting will not be permitted.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

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- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.
- e. Hard materials and rock will not be encountered.

#### 1.7 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

### PART 2 PRODUCTS

#### 2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

#### 2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

##### Warning Tape Color Codes

|         |                                       |
|---------|---------------------------------------|
| Red:    | Electric                              |
| Yellow: | Gas, Oil; Dangerous Materials         |
| Orange: | Telephone and Other<br>Communications |
| Blue:   | Water Systems                         |
| Green:  | Sewer Systems                         |
| White:  | Steam Systems                         |
| Gray:   | Compressed Air                        |

##### 2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum

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thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

#### 2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.

Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

#### 2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

#### 2.4 MATERIAL FOR RIP-RAP

Provide Bedding material, filter fabric and rock conforming to ODOT Standard Specification Section 601.

##### 2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inch. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

##### 2.4.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

### PART 3 EXECUTION

#### 3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches and as required by ODOT Section 205. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inch in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile within project site or in location directed. Any surplus of topsoil from excavations and gradings shall be delivered to area indicated in the drawings.

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### 3.2 GENERAL EXCAVATION

The excavation for the building slab on grade shall be as required by the contractor completed geotechnical evaluation and building structural design engineer. Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in ODOT Standard Specification Section 209 and in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated at the Ft. Sill Sanitary Landfill. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

#### 3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose of excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

#### 3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

#### 3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and

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provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

#### 3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 2 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

#### 3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 3 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than 6 feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inch inside diameter, and do not exceed 36 inch plus pipe outside diameter for sizes larger than 24 inch inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

##### 3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 2 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

##### 3.2.5.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, remove such material 6 inches below the required grade and replace with suitable materials as provided in paragraph



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#### BACKFILLING AND COMPACTION.

##### 3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

##### 3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inch clear between the outer structure surfaces and the face of the excavation or support members. Clean rock of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

##### 3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

##### 3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

#### 3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas from off site approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related

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operations to the borrow excavation.

### 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor is responsible for notifying the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

### 3.5 SHORING

#### 3.5.1 General Requirements

Submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheet piling as excavations are backfilled, in a manner to prevent caving.

#### 3.5.2 Geotechnical Engineer

The Contractor is required to hire a Professional Geotechnical Engineer licensed in the State of Oklahoma to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheet piling and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

### 3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

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### 3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE PAVEMENTS (not including building slabs)

Do not excavate to final grade until just before concrete is to be placed. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

### 3.8 GROUND SURFACE PREPARATION

#### 3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inch, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to plus 3% or minus 1% to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

#### 3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost.

### 3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

### 3.10 BURIED TAPE AND DETECTION WIRE

#### 3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inch below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

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### 3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

### 3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed as specified in paragraph GROUND SURFACE PREPARATION. Provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

#### 3.11.1 Trench Backfill

Backfill the trench to 2 feet above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test. Do not backfill the trench until all specified tests are performed.

##### 3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

##### 3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inch loose thickness.

##### 3.11.1.3 Initial Backfill

Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D 1557 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

- a. Clean, coarsely graded natural gravel, crushed stone or a combination thereof in accordance with ODOT Standard Specification Section 703.05 classification of GW or GP in accordance with

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ASTM D 2487 for backfill as indicated. Do not exceed maximum particle size of 3 inches or as required by pipe manufacturer.

#### 3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

- a. Roadways: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inch loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

#### 3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, or until concrete has obtained 70% design strength place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

#### 3.12.1 Gas Distribution

All work for Gas Distribution Piping, up to and including the meter, shall be completed by Oklahoma Natural Gas.

Installation of new mains or service shall be done at no cost to the Contractor or Government but the costs for relocation of existing mains shall be reimbursed by the Government to ONG.

#### 3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 6 inches of cover is required.

#### 3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

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#### 3.12.4 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

### 3.13 EMBANKMENTS

#### 3.13.1 Earth Embankments

Construct earth embankments in accordance with this Section and ODOT Standard Specification Section 202, from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 9 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.14 SUBGRADE PREPARATION

#### 3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade as required below or in Test Rolling, Section 203 and Section 310 of ODOT Standard Specifications. After stripping, proof roll the existing subgrade of the areas for pavement with six passes of a dump truck loaded with 4 cubic yards of soil or 15 ton, pneumatic-tired roller. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material to a depth of 12 inches and replace with fill and backfill or select material.

#### 3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inch below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. When tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. After rolling, do not show deviations for the surface of the subgrade for airfields greater than 1/4 inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area.

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Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

### 3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 85 percent of laboratory maximum density.

#### 3.14.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percent laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 6 inches of subgrade.

#### 3.14.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the depth below the surface of shoulder shown.

### 3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

### 3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

#### 3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. The Contractor is responsible for protecting and maintaining the finished subgrade in a satisfactory condition until ballast, subbase, base, or

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pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

### 3.16.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inch depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 4 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

### 3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 1556 or ASTM D 2167 or/and ASTM D 2922. When ASTM D 2922 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil to determine the moisture content of the soil when using this method ASTM D 3017. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D 3017; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint an Oklahoma registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### 3.18.1 Fill and Backfill Material Gradation

One test per 500 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136 ASTM D 422 ASTM D 1140.

#### 3.18.2 In-Place Densities

- a. One test per 2500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated



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machines.

- b. One test per 250 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
- c. One test per 100 linear feet, or fraction thereof, of each lift of embankment or backfill for utility trenches or 50 feet for trenches below structures.

#### 3.18.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, check in-place densities by ASTM D 1556 as follows:

- a. One check test per lift for each 15,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 2,500 square feet, of fill or backfill areas compacted by hand-operated machines.
- c. One check test per lift for each 500 linear feet, or fraction thereof, of embankment or backfill for utility trenches.

#### 3.18.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

#### 3.18.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

#### 3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

#### 3.18.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inch, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

#### 3.19 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable

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for filling or backfilling, and brush, refuse, stumps, roots, and  
NED/timber as wasted in Government disposal area indicated which is located  
within a haul distance of 5 miles at the Ft. Sill Sanitary Landfill.

-- End of Section --



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SECTION 31 11 00

CLEARING AND GRUBBING  
04/06

PART 1 GENERAL

1.1 REFERENCES

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD CONSTRUCTION  
SPECIFICATIONS

Section 201

Clear and Grubbing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials; G

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

SD-04 Samples

Tree wound paint

Herbicide

Submit samples in cans with manufacturer's label.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

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### PART 3 EXECUTION

#### 3.1 PROTECTION

##### 3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

##### 3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. See Section 02 41 00 for additional requirements.

##### 3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Division 01 Specifications.

#### 3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work and shall conform to ODOT Standard Specification Section 201. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

#### 3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

Tree removal shall not occur during migratory bird season (April-June) in accordance with the Migratory Bird Treaty Act. Ft. Sill Natural Resources office must check all trees designated for removal for nests, etc. prior to removal, contact Glen Wompler EQD (580) 442-4324. Contractor shall not remove trees without written approval of Contracting Officer and Natural Resources office. Natural Resources office will also designate a location

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for the disposal of trees that will benefit wildlife habitat and soil erosion control concerns.

### 3.4 PRUNING

Prune or trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

### 3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas and shall conform to ODOT Standard Specification Section 201. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

### 3.6 DISPOSAL OF MATERIALS

#### 3.6.1 Saleable Timber

All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of off stations.

#### 3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of in the designated waste disposal area, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --



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SECTION 32 01 19

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS  
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

|             |  |
|-------------|--|
| ASTM C 509  | (2000) Elastomeric Cellular Preformed Gasket and Sealing Material  |
| ASTM D 5893 | (2004) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements |
| ASTM D 6690 | (2006) Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements                                       |
| ASTM D 789  | (2004) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)                                      |

U.S. ARMY CORPS OF ENGINEERS (USACE)

|               |   |
|---------------|---|
| COE CRD-C 525 | (1989) Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating |
|---------------|---|

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations; G.

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these recommendations, 30 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

Equipment.

List of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use



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on the project.

#### SD-04 Samples

Materials; G.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 30 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

### 1.3 SAFETY

Joint sealant shall not be placed within 25 feet of any liquid oxygen (LOX) equipment, LOX storage, or LOX piping. Joints in this area shall be thoroughly cleaned and left unsealed.

### 1.4 TEST REQUIREMENTS

The joint sealant and backup or separating material shall be tested for conformance with the referenced applicable material specification. The materials will be tested by the Government. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements. The cost of the first test of samples shall be borne by the Government. If the samples fail to meet specification requirements, the materials represented by the sample shall be replaced and the new materials tested at the Contractor's expense. Testing of the materials shall be performed in an approved independent laboratory and certified copies of the test reports shall be submitted and approved 30 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

### 1.5 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

#### 1.5.1 Joint Cleaning Equipment

##### 1.5.1.1 Tractor-Mounted Routing Tool

The routing tool used for removing old sealant from the joints shall be of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

##### 1.5.1.2 Concrete Saw

A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not

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provide a clean joint.

#### 1.5.1.3 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and shall be capable of furnishing not less than 150 cfm and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Compressor capability under job conditions must be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjusted as necessary to secure satisfactory results.

#### 1.5.1.4 Waterblasting Equipment

Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjustable as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.

#### 1.5.1.5 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

#### 1.5.2 Sealing Equipment

##### 1.5.2.1 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing ASTM D 6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

##### 1.5.2.2 Cold-Applied, Single-Component Sealing Equipment

The equipment for installing ASTM D 5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. The initially approved equipment shall be maintained in good working condition, serviced in accordance with the supplier's

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instructions, and shall not be altered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

#### 1.6 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 200 feet long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

#### 1.7 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided by the Contractor at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

#### 1.8 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the joint.

### PART 2 PRODUCTS

#### 2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

| Area   | Sealing Material   |
|--|--|
| Tactical Roads or Hard-stands or Vehicle Pavements | ASTM D 6690, Type II and COE CRD-C 525 or<br>ASTM D 6690, Type III and COE CRD-C 525 or<br>ASTM D 5893 |

#### 2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, their use shall be in accordance with the recommendation of the manufacturer.

#### 2.3 BACKUP MATERIALS

The backup material shall be a compressible, nonshrinking, nonstaining, nonabsorbing material and shall be nonreactive with the joint sealant. The

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material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

## 2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

## PART 3 EXECUTION

### 3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, the joints shall be thoroughly cleaned to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

#### 3.1.1 Existing Sealant Removal

The in-place sealant shall be cut loose from both joint faces and to the depth shown on the drawings, using the tractor-mounted routing equipment, concrete saw, waterblaster as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any separating or backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, all loose old sealant remaining in the joint opening shall be removed by blowing with compressed air. Hand tools may be required to remove sealant from random cracks. Chipping, spalling, or otherwise damaging the concrete will not be allowed.

#### 3.1.2 Sawing

##### 3.1.2.1 Refacing of Joints

Refacing or facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT to remove all residual old sealant and a minimum of concrete from the joint face to provide exposure of newly cleaned concrete, and, if required, to enlarge the joint opening to the width and depth shown on the drawings or to saw through sawed and filler-type joints to loosen and remove material until the joint is clean and open to the full specified width and depth. The blade shall be stiffened with a sufficient number of suitable dummy (used) blades or washers. Immediately following the sawing operation, the joint opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

##### 3.1.2.2 Refacing of Random Cracks

Sawing of the cracks shall be accomplished using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 6 inches or less in diameter to enable the saw to follow the trace of the crack.

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The blade shall be stiffened as necessary with suitable dummy (or used) blades or washers. Immediately following the sawing operation, the crack opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

### 3.1.3 Waterblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be waterblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

### 3.1.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, the lower portion of the joint opening shall be plugged or sealed off using a back-up material to prevent the entrance of the sealant below the specified depth. Care shall be taken to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

### 3.1.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

### 3.1.6 Rate of Progress of Joint Preparation

The stages of joint preparation which include sandblasting, air pressure cleaning and placing of the back-up material shall be limited to only that lineal footage that can be sealed during the same day.

## 3.2 PREPARATION OF SEALANT

### 3.2.1 Hot-Poured Sealants

Sealants conforming to ASTM D 6690 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and wasted.

### 3.2.2 Single-Component, Cold-Applied Sealants

The ASTM D 5893 sealant and containers shall be inspected prior to use. Any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory shall be rejected. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

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### 3.3 INSTALLATION OF SEALANT

#### 3.3.1 Time of Application

Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

#### 3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 1/4 inch plus or minus 1/16 inch below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

### 3.4 INSPECTION

#### 3.4.1 Joint Cleaning

Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of the separating or back-up material and joint sealant.

#### 3.4.2 Joint Sealant Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

#### 3.4.3 Joint Sealant

The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

### 3.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site and the pavement shall be left in a clean condition.

-- End of Section --

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SECTION 32 05 33

LANDSCAPE ESTABLISHMENT

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z133.1 (2001) Arboricultural Operations -- Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush

ASTM INTERNATIONAL (ASTM)

ASTM D 5851 (1995; R 2000) Planning and Implementing a Water Monitoring Program

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

1.2.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematocides, molluscicides and rodenticides.

1.2.2 Stand of Turf

95 percent ground cover of the established species.

1.2.3 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: shrubs, vines, wildflowers, annuals, perennials, ground cover, and a mulch topdressing excluding turf. Trees may also be found in planter beds.

1.3 RELATED REQUIREMENTS

Section 32 92 19 SEEDING applies to this section for installation of seed



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requirements, with additions and modifications herein.

Section 32 92 23 SODDING applies to this section for installation of sodding requirements, with additions and modifications herein.

Section 32 93 00 EXTERIOR PLANTS applies to this section for installation of exterior plant requirements, with additions and modifications herein.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-01 Preconstruction Submittals

Integrated Pest Management Plan; G

##### SD-03 Product Data

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Fertilizer; G

Hose; (LEED)

Mulches Topdressing; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Organic Mulch Materials

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

##### SD-07 Certificates

Maintenance inspection report

Plant quantities; G

##### SD-10 Operation and Maintenance Data

Maintenance

##### SD-11 Closeout Submittals

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Tree, staking and guying removal

## 1.5 DELIVERY, STORAGE AND HANDLING

### 1.5.1 Delivery

Deliver fertilizer, to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, may be furnished in bulk with a certificate indicating the above information.

### 1.5.2 Storage

#### 1.5.2.1 Fertilizer, Mulch Storage

Material shall be stored in designated areas. Fertilizer shall be stored in cool, dry locations away from contaminants.

#### 1.5.2.2 Antidessicants Storage

Do not store with fertilizers or other landscape maintenance materials.

### 1.5.3 Handling

Do not drop or dump materials from vehicles.

## 1.6 SUSTAINABLE DESIGN REQUIREMENTS

### 1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. Landscaping materials may be locally available.

## 1.7 MAINTENANCE

Submit Operation and Maintenance (O&M) Manuals for planting materials. Include instructions indicating procedures during one typical year including variations of maintenance for climatic conditions throughout the year. Provide instructions and procedures for watering; promotion of growth, including fertilizing, pruning, and mowing; and integrated pest management. O&M Manuals shall include pictures of planting materials cross referenced to botanical and common names, with a description of the normal appearance in each season.

Develop a water monitoring program for surface and ground water on the project site in accordance with ASTM D 5851 and consistent with the water management program utilized during construction operations.

## PART 2 PRODUCTS

### 2.1 POST-PLANT FERTILIZER

Fertilizer for groundcover, wildflowers, and grasses is not permitted. Fertilizer for trees, plants, and shrubs shall be as recommended by plant supplier, except synthetic chemical fertilizers are not permitted. Fertilizers containing petrochemical additives or that have been treated

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with pesticides or herbicides are not permitted.

#### 2.1.1 Granular Fertilizer

As specified in Section 32 92 19 SEEDING.

#### 2.2 WATER

Source of water shall be approved by the Contracting Officer, and be of suitable quality for irrigation.

##### 2.2.1 Hose

Hoses used for watering shall be a minimum of 60 percent post-consumer rubber or plastic.

#### 2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, pesticides, or other deleterious materials.

##### 2.3.1 Inert Mulch Materials

Provide materials from site and construction waste to the greatest extent possible. Mulch shall contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Mulch may contain post-consumer or post-industrial recycled content.

##### 2.3.2 Organic Mulch Materials

Wood cellulose fiber, wood chips, ground or shredded bark or shredded hardwood, recycled from site when available. Biobased content shall be a minimum of 100 percent. Wood cellulose fiber shall be processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application. Paper-based hydraulic mulch shall contain a minimum of 100 percent post-consumer recycled content. Wood-based hydraulic mulch shall contain a minimum of 100 percent recycled material.

##### 2.3.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inch screen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inch length. The material shall be treated to retard the growth of mold and fungi.

#### 2.4 PESTICIDES

Pesticides and herbicides are not permitted. Submit an Integrated Pest Management Plan, including proposed alternatives to herbicides and pesticides. Use biological pest controls as approved in the Plan.

### PART 3 EXECUTION

#### 3.1 EXTENT OF WORK

Provide landscape construction maintenance to include mowing, edging, overseeding, aeration, fertilizing, watering, weeding, pruning, and stake

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and guy adjusting, for all newly installed or renovated landscape areas and existing plant material, unless indicated otherwise, and at all areas inside or outside the limits of the construction that are disturbed by the Contractor's operations.

#### 3.1.1 Policing

The Contractor shall police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Collected debris shall be promptly removed and disposed of at an approved disposal site.

#### 3.1.2 Drainage System Maintenance

The Contractor shall remove all obstructions from surface and subsurface drain lines to allow water to flow unrestricted in swales, gutters, catch basins, storm drain curb inlets, and yard drains. Remove grates and clear debris in catch basins. Open drainage channels are to be maintained free of all debris and vegetation at all times. Edges of these channels shall be clear of any encroachment by vegetation.

#### 3.2 GROUNDCOVER ESTABLISHMENT PERIOD

Groundcover establishment period will commence on the date that inspection by the Contracting Officer shows that the new or renovated turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. The establishment period shall continue for a period of 365 days.

##### 3.2.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed or fully renovated. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly.

##### 3.2.2 Promotion of Growth

Groundcover shall be maintained in a manner that promotes proper health, growth, natural color. Turf shall have a neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, aerate, topdress and perform other operations necessary to promote growth, as approved by Contracting Officer and consistent with approved Integrated Pest Management Plan. Remove noxious weeds common to the area from planting areas by mechanical means.

##### 3.2.3 Mowing

###### 3.2.3.1 Turf

Turf shall be mowed at a uniform finished height. Mow turfed areas to a minimum average height of 3 inches when average height of grass becomes 4 inches for spring/summer maintenance and to a minimum average height of 3 inches when the average height of grass reaches 4 inches for fall and winter maintenance. The height of turf is measured from the soil. Mowing of turf shall be performed in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Prior to mowing, all rubbish, debris,

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trash, leaves, rocks, paper, and limbs or branches on a turf area shall be picked up and disposed. Adjacent paved areas shall be swept/vacuumed clean.

#### 3.2.3.2 Native Grasses

Mow above height of native grass seedlings (approximately 3.5 to 4 inches). Mow during spring or early summer. Do not mow after early summer during the second growing season.

#### 3.2.3.3 Wildflowers

Mow three times per season above height of the wildflowers (approximately 12 to 15 inches).

#### 3.2.4 Turf Edging and Trimming

Perimeter of planter bed edges, sidewalks, driveways, curbs, and other paved surfaces shall be edged. Uniformly edge these areas to prevent encroachment of vegetation onto paved surfaces and to provide a clear cut division line between planter beds, turf, and ground cover. Edging is to be accomplished in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Edging shall be performed on the same day that turf is mowed. Use of string line trimmers is permitted in "soft" areas such as an edge between turfgrass and a planter bed. Care shall be exercised to avoid damage to any plant materials, structures, and other landscape features.

Trimming around trees, fences, poles, walls, irrigation valve boxes and other similar objects is to be accomplished to match the height and appearance of surrounding mowed turf growth. Trimming shall be performed on the same day the turf's mowed. Care shall be exercised to avoid "Girdling" trees located in turf areas. The use of protective tree collars on trees in turf areas may be utilized as a temporary means to avoid injury to tree trunks. At the end of the plant establishment period Contractor will be responsible for removing all protective tree collars.

#### 3.2.5 Post-Fertilizer Application

Do not fertilize wildflowers, groundcover, and grasses. Apply turf fertilizer in a manner that promotes health, growth, vigor, color and appearance of cultivated turf areas. The method of application, fertilizer type and frequencies shall be determined by the laboratory soil analysis results the requirements of the particular turf species. Organic fertilizer shall be used. In the event that organic fertilizer is not producing the desired effect, the Contractor shall contract the Contracting Officer for approval prior to the use of a synthetic type of fertilizer. Fertilizer shall be applied by approved methods in accordance with the manufacturer's recommendations.

#### 3.2.6 Turf Watering

The Contractor shall perform irrigation in a manner that promotes the health, growth, color and appearance of cultivated vegetation and that complies with all Federal, State, and local water agencies and authorities directives. The Contractor shall be responsible to prevent over watering, water run-off, erosion, and ponding due to excessive quantities or rate of application. The Contractor shall abide by state, local or other water conservation regulations or restrictions in force during the establishment period.

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### 3.2.7 Turf Aeration

Upon completion of weed eradication operations and Contracting Officer's approval to proceed, aerate turf areas by approved device. Core, by pulling soil plugs, to a minimum depth of 3 inches. Leave all soil plugs that are produced in the turf area.

Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete. This work shall commence 60 days prior final acceptance of the maintenance establishment period.

### 3.2.8 Turf Clearance Area

Trees located in turf areas shall be maintained with a growth free clearance of 18 inches from the tree trunk base. The use of mechanical weed whips to accomplish the turf growth free bed area is prohibited.

### 3.2.9 Replanting

Replant in accordance with Section 32 92 19 SEEDING and 32 92 23 SODDING and within specified planting dates areas which do not have a satisfactory stand of turf. Replant areas which do not have a satisfactory stand of other groundcover and grasses.

### 3.2.10 Final Inspection and Acceptance

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final turf acceptance will be based upon a satisfactory stand of turf. Final acceptance of wildflower and grass areas will be based upon a stand of 95 percent groundcover of established species.

### 3.2.11 County Agricultural Agent

The county agricultural agent may be contacted through: Comanche County Extension Office, 611 SW C. Ave., Lawton OK 73501, phone 580-355-1176, fax 580-353-5896, email: avandev@okstate.edu.

### 3.2.12 Unsatisfactory Work

When work is found to not meet design intent and specifications, maintenance period will be extended at no additional cost to the Government until work has been completed, inspected and accepted by Contracting Officer.

## 3.3 EXTERIOR PLANT ESTABLISHMENT PERIOD

The exterior plant establishment period will commence on the date that inspection by the Contracting Officer shows that the transplanted plants furnished under this contract have been satisfactorily installed and shall continue for a period of 365 days.

### 3.3.1 Frequency of Maintenance

Begin maintenance immediately after plants have been installed. Inspect exterior plants at least once a week during the installation and establishment period and perform needed maintenance promptly.

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### 3.3.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant growth, and vigor.

### 3.3.3 Planter Bed Maintenance

#### 3.3.3.1 Tree Maintenance

Tree maintenance shall include adjustment of stakes, ties, guy supports and turnbuckles, watering, fertilizing, pest control, mulching, pruning for health and safety and fall leaf cleanup. Fertilize exterior trees to promote healthy plant growth without encouraging excessive top foliar growth. Stakes, ties, guy supports and turnbuckles shall be inspected and adjusted to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, shall be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees including palm trees shall be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with ANSI Z133.1. All pruning debris generated shall be disposed of in a proper manner.

### 3.3.4 Slope Erosion Control Maintenance

The Contractor shall provide slope erosion control maintenance to prevent undermining of all slopes in newly landscaped and natural growth areas. Maintenance tasks include immediate repairs to weak spots in sloped areas, and maintaining clean, clear culverts, and graded berms, and terraces to intercept and direct water flow to prevent development of large gullies and slope erosion. Eroded areas shall be filled with amended topsoil and replanted with the same plant species. Erosion control netting or blankets damaged due to slope erosion shall be reinstalled.

### 3.3.5 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace stakes, guys, mulch and eroded earth mound water basins. No additional plant establishment period will be required for replacement plants beyond the original warranty period. A tree shall be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover shall be considered dying or dead when a minimum of 20 percent of the plant has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine the cause for dying plant material and shall provide recommendations for replacement. The Contractor shall determine the cause for dying plant material and provide recommendations for replacement.

### 3.3.6 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Contracting Officer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as originally specified. Install replacement plantings in accordance with Section 32 96 00 TRANSPLANTING EXTERIOR PLANTS.

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### 3.3.7 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

#### 3.3.7.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

#### 3.3.7.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

#### 3.3.7.3 Tree Supports

Stakes, guys, and turnbuckles are in good condition.

#### 3.3.7.4 Remedial Work

Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

### 3.3.8 Unsatisfactory Work

When work is found to not meet design intent and specifications, maintenance period will be extended at no additional cost to the Government until work has been completed, inspected and accepted by Contracting Officer.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations shall be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Results of site observation visits shall be submitted to the Contracting Officer within 7 calendar days of each site observation visit.

### 3.4.2 Plant Quantities

The Contractor shall provide Contracting Officer with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

### 3.4.3 Tree Staking and Guying Removal

The Contractor shall provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --





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## SECTION 32 11 23

## GRADED-CRUSHED AGGREGATE BASE COURSE

04/06

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 180 (2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C 117 (2004) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 127 (2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 128 (2004a) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2005) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 29/C 29M (1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 88 (2005) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

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| ASTM D 2167 | (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method  |
| ASTM D 2487 | (2000) Soils for Engineering Purposes (Unified Soil Classification System)            |
| ASTM D 2922 | (2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 3017 | (2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)     |
| ASTM D 4318 | (2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils                     |
| ASTM D 75   | (2003) Sampling Aggregates  |
| ASTM E 11   | (2004) Wire Cloth and Sieves for Testing Purposes                                     |

#### OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

|             |  |
|-------------|--|
| Section 301 | General Requirements for Bases         |
| Section 303 | Aggregate Base                         |
| Section 703 | Mineral Aggregates, Miscellaneous Uses |

### 1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

#### 1.2.1 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

Contractor may substitute ODOT Standard Specification Section 703, Type A, in lieu of this specification.

#### 1.2.2 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve shall be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

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used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

SD-06 Test Reports

Sampling and Testing; G  
Field Density Tests; G

Certified copies of test results for approval not less than 30 days before material is required for the work.

Calibration curves and related test results prior to using the device or equipment being calibrated.

Copies of field test results within 24 hours after the tests are performed.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01 44 00 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

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#### 1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

#### 1.4.2.3 Moisture-Density Determinations

The laboratory maximum dry density and optimum moisture content shall be determined in accordance with ASTM D 1557 or AASHTO T 180, Method D and corrected with AASHTO T 224.

#### 1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

#### 1.4.2.5 Wear Test

Wear tests shall be made on GCA course material in conformance with ASTM C 131.

#### 1.4.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

#### 1.4.2.7 Weight of Slag

Weight per cubic foot of slag shall be determined in accordance with ASTM C 29/C 29M on the GCA course material.

#### 1.4.3 Testing Frequency

##### 1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.

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e. Soundness.

1.4.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted GCA. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards or portion thereof, of completed area.

b. Sieve Analysis shall be performed on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

d. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

1.4.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work shall be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.7 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used, as specified in the Submittals paragraph.

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## PART 2 PRODUCTS

### 2.1 AGGREGATES

The GCA shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material, Contractor may substitute ODOT Standard Specification Section 703, Type A, in lieu of this specification. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

#### 2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

##### 2.1.1.1 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with ASTM C 88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

#### 2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

##### 2.1.2.1 Graded-Crushed Aggregate Base Course

GCA fine aggregate shall consist of angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be produced by

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crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve. Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 1/2 inch sieve.

### 2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

| Sieve<br>Designation | GCA    |
|----------------------|--------|
| -----                | -----  |
| 2 inch               | ----   |
| 1-1/2 inch           | 100    |
| 1 inch               | 60-100 |
| 1/2 inch             | 30-65  |
| No. 4                | 20-50  |
| No. 10               | 15-40  |
| No. 40               | 5-25   |
| No. 200              | 0-8    |

NOTE 1: Particles having diameters less than shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

## 2.2 LIQUID LIMIT AND PLASTICITY INDEX

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

Construction of Base Courses shall conform to ODOT Standard Specification Section 301 and Section 303. When the GCA is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of



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construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

### 3.2 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specifications requirements in the specified time limit. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

### 3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

### 3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

### 3.5 INSTALLATION

#### 3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification. Adjustments to the JMF shall be limited to plus or minus 5 percent on the 1-1/2 inch and coarser sieves; plus or minus 8 percent on the 1 inch to No. 4 sieves; plus or minus 5 percent on the No. 30 sieve, and plus or minus 3 percent on the No. 200 sieve. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; this is acceptable.

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### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

### 3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

### 3.5.4 Edges of Base Course

The base course(s) shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

### 3.5.5 Compaction

Each layer of the base course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with

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satisfactory material or reworked, as directed, to meet the requirements of this specification.

#### 3.5.6 Thickness

Compacted thickness of the base course shall be as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

#### 3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. In areas designated, proof rolling shall be applied to the top of the underlying material on which the base course is laid and to each layer of base course. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the base course shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any base course materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

#### 3.5.8 Finishing

The surface of the top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

#### 3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved.

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Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

### 3.6 TRAFFIC

Traffic shall not be allowed on the completed base course. Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary for construction, and then the area shall be protected against marring or damage to the completed work.

### 3.7 MAINTENANCE

The base course shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of outside in waste disposal areas indicated. No additional payments will be made for materials that must be replaced.

-- End of Section --



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SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS  
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 102 (1983; R 2000) Spot Test of Asphaltic Materials

AASHTO T 40 (2002) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D 140 (2001) Sampling Bituminous Materials

ASTM D 2027 (1997; R 2004) Cutback Asphalt  
(Medium-Curing Type)

ASTM D 2397 (2002) Cationic Emulsified Asphalt

ASTM D 2995 (1999; R 2004) Determining Application  
Rate of Bituminous Distributors

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

Section 407 Tack Coat

Section 408 Prime Coat

Section 703 Mineral Aggregate, Miscellaneous Uses

Section 708 Plant Mix Bituminous Bases and Surfaces

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing

Copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests.

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Certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt, compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

### 1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

#### 1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory within 12 months prior to commencing work and every 6 months thereafter, by such laboratory from the date of recalibration, during the term of the contract.

#### 1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number that the load produced on the base surface shall not exceed 650 psi of tire width and to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

#### 1.3.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Steam heaters shall consist of steam coils and equipment for producing steam, so designed that the steam cannot get into the material. An armored thermometer with a temperature range from 40 to 400 degrees F shall be fixed to the tank so that the temperature of the bituminous material may be determined at all times.

#### 1.3.4 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

### 1.4 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise directed.

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### 1.5 DELIVERY AND STORAGE

Inspect the materials delivered to the site for contamination and damage.  
Unload and store the materials with a minimum of handling.

## PART 2 PRODUCTS

### 2.1 PRIME COAT

Asphalt shall conform to ODOT Standard Specification Section 708.

#### 2.1.1 Cutback Asphalt

Cutback asphalt shall conform to ASTM D 2027, Grade MC-30 or MC-70.

### 2.2 TACK COAT

Asphalt shall conform to ODOT Standard Specification Section 703.

#### 2.2.1 Emulsified Asphalt

Emulsified asphalt shall conform to ASTM D 2397, Type CSS-1, CSS-1h, SS-1, and SS-1h. Dilute the emulsified asphalt with equal parts of water. The base asphalt used to manufacture the emulsion shall show a negative spot when tested in accordance with AASHTO T 102 using standard naphtha.

## PART 3 EXECUTION

### 3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated by means of a power broom or blower supplemented with hand brooms. The surface shall be dry and clean at the time of treatment.

### 3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

#### 3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

#### 3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

### 3.3 APPLICATION TEMPERATURE

#### 3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the



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Contracting Officer.

### 3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

#### Liquid Asphalts

|       |                   |
|-------|-------------------|
| MC-30 | 85-190 degrees F  |
| MC-70 | 120-225 degrees F |

#### Emulsions

|        |                  |
|--------|------------------|
| CSS-1  | 70-160 degrees F |
| CSS-1h | 70-160 degrees F |
| SS-1   | 70-160 degrees F |
| SS-1h  | 70-160 degrees F |

\*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

### 3.4 APPLICATION

#### 3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous prime or tack coat shall be applied with the Bituminous Distributor at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

#### 3.4.2 Prime Coat

A prime coat shall be applied at locations shown on the Drawings and in accordance with ODOT Standard Specification Section 408. The prime coat will be required if it will be at least 7 days before the surfacing (Asphalt cement hot mix concrete) layer is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. The Contractor shall protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Damage to the underlying material caused by lack of, or inadequate, protection shall be repaired (recompacted or replaced) by approved methods at no additional cost to the Government. If the

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Contractor options to use the prime coat, it shall be applied as soon as possible after consolidation of the underlying material. Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi and at the rate of not less than 0.20 gallon nor more than 0.30 gallon per square yard. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application, the building paper shall be removed and destroyed.

#### 3.4.3 Tack Coat

Tack coat shall be applied at the locations shown on the drawings and in accordance with ODOT Standard Specification Section 407. Apply the tack coat when the surface to be treated is dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate of not less than 0.05 gallon nor more than 0.15 gallon of diluted emulsion per square yard. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor with the bituminous material. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

#### 3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material.

#### 3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 1000 gallons of bituminous material used. The sample may be retained and tested by the Government at no cost to the Contractor.

#### 3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

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### 3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

### 3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

### 3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 100 feet for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied. All rakes are residual rates of asphalt cement.

#### 3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

#### 3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

### 3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

## 3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --

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SECTION 32 12 16

HOT-MIX ASPHALT (HMA) FOR ROADS  
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 320 (2003) Performance-Graded Asphalt Binder

ASPHALT INSTITUTE (AI)

AI MS-02 (6th Edition; 1997) Mix Design Methods for Asphalt

AI MS-22 (2nd Edition; 2001) Construction of Hot-Mix Asphalt Pavements

AI-SP-1 Superpave Performance Graded Asphalt Binder Specs and Testing

ASTM INTERNATIONAL (ASTM)

ASTM C 117 (2004) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 1252 (2003) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)

ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2005) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 142 (1997; R 2004) Clay Lumps and Friable Particles in Aggregates

ASTM C 29/C 29M (1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 566 (1997; R 2004) Total Evaporable Moisture Content of Aggregate by Drying

ASTM C 88 (2005) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

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|                     |   |
|---------------------|---|
| ASTM D 140          | (2001) Sampling Bituminous Materials  |
| ASTM D 1461         | (1985; R 2001) Moisture or Volatile Distillates in Bituminous Paving Mixtures                   |
| ASTM D 2041         | (2003a) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures          |
| ASTM D 2172         | (2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures                     |
| ASTM D 2419         | (2002) Sand Equivalent Value of Soils and Fine Aggregate  |
| ASTM D 242          | (1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures                                  |
| ASTM D 2489         | (2002) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures                   |
| ASTM D 2726         | (2004) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures        |
| ASTM D 2950         | (1991; R 1997) Density of Bituminous Concrete in Place by Nuclear Methods                       |
| ASTM D 3665         | (2002) Random Sampling of Construction Materials  |
| ASTM D 3666         | (2004) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials       |
| ASTM D 4125         | (1994;R 2000) Asphalt Content of Bituminous Mixtures by the Nuclear Method                      |
| ASTM D 4791         | (1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate |
| ASTM D 4867/D 4867M | (2004) Effect of Moisture on Asphalt Concrete Paving Mixtures                                   |
| ASTM D 5444         | (1998) Mechanical Size Analysis of Extracted Aggregate  |
| ASTM D 6307         | (2004) Asphalt Content of Hot Mix Asphalt by Ignition Method                                    |
| ASTM D 6926         | (2004) Preparation of Bituminous Specimens Using Marshall Apparatus                             |
| ASTM D 6927         | (2005e1) Marshall Stability and Flow of Bituminous Mixtures                                     |
| ASTM D 995          | (1995b; R 2002) Mixing Plants for   |

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Hot-Mixed, Hot-Laid Bituminous Paving  
Mixtures

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

|             |   |
|-------------|---|
| Section 401 | General Requirements for Surfaces       |
| Section 411 | Plant Mix Asphalt Concrete Pavement     |
| Section 708 | Plant Mix Bituminous Bases and Surfaces |

U.S. ARMY CORPS OF ENGINEERS (USACE)

|               |  |
|---------------|--|
| COE CRD-C 171 | (1994) Standard Test Method for<br>Determining Percentage of Crushed<br>Particles in Aggregate |
|---------------|--|

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for approval information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G

Proposed JMF.

Contractor Quality Control; G

Quality control plan.

Material Acceptance; G

Acceptance test results and pay calculations.

SD-04 Samples

Asphalt Cement Binder

A 5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

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#### SD-06 Test Reports

Aggregates; G  
QC Monitoring

Aggregate and QC test results.

#### SD-07 Certificates

Asphalt Cement Binder; G

Copies of certified test data.

Amount, type and description of any modifiers blended into the  
asphalt cement binder

Testing Laboratory

Certification of compliance.

Plant Scale Calibration Certification

### 1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 and ODOT Standard Specification Section 411 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

c. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

### 1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not

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be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

#### 1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

##### 1.6.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

##### 1.6.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 30 feet in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.
- d. Laser control.

#### 1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

#### 1.8 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including



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compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

| Mat Thickness, inches | Degrees F |
|-----------------------|-----------|
| 3 or greater          | 40        |
| Less than 3           | 45        |

## PART 2 PRODUCTS

### 2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

#### 2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

- a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.
- b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate or 12 percent when using sodium sulfate.
- c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.
- d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20% percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.
- e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 75 lb/cu ft when tested in accordance with ASTM C 29/C 29M.
- f. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142.

#### 2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls.

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- a. All individual fine aggregate sources shall have a sand equivalent value not less than 45 when tested in accordance with ASTM D 2419.
- b. The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 45.0 percent when tested in accordance with ASTM C 1252 Method A.
- c. The quantity of natural sand (noncrushed material) added to the aggregate blend shall not exceed 25 percent by weight of total aggregate.
- d. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142

#### 2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

#### 2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

| <u>Sieve Size, inch</u> | <u>Percent Passing<br/>by Mass</u> |
|-------------------------|------------------------------------|
| 1                       | ---                                |
| 3/4                     | 100                                |
| 1/2                     | 76-96                              |
| 3/8                     | 69-89                              |
| No. 4                   | 53-73                              |
| No. 8                   | 38-60                              |
| No. 16                  | 26-48                              |
| No. 30                  | 18-38                              |
| No. 50                  | 11-27                              |
| No. 100                 | 6-18                               |
| No. 200                 | 3-6                                |

#### 2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 70-22 or G4-22. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before

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start of the test section.

## 2.3 MIX DESIGN

a. The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-02 and the criteria shown in Table 3. The hand-held hammer shall be used to compact the specimens. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

b. At the option of the Contractor a currently used ODOT Standard Specification Section 708, Type B Surface Course and Type A Intermediate Course hot mix may be used in lieu of developing a Marshall hot mix design as described herein. The nominal maximum aggregate size (NMAS) shall be 1-1/2 inch. The mix design shall be designed in accordance with AI-SP-1.

### 2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hand-held hammer per side of molded specimen.
- f. Laboratory mixing temperature.
- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.
- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.
- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.

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- m. Percent particles with 2 or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.
- o. Percent flat or elongated particles (in coarse aggregate).
- p. Tensile Strength Ratio(TSR).
- q. Antistrip agent (if required) and amount.
- r. List of all modifiers and amount.
- s. Correlation of hand-held hammer with mechanical hammer.
- t. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

| <u>Test Property</u>  | <u>50 Blow Mix</u> | <u>75 Blow Mix</u> |
|---|--------------------|--------------------|
| Stability, pounds<br>minimum                                | *1000              | *1800              |
| Flow, 0.01 inch   | 8-18               | 8-16               |
| Air voids, percent  | 3-5                | 3-5                |
| Percent Voids in<br>mineral aggregate VMA,<br><br>(minimum) |                    |                    |
| Gradation 2   | 14.0               | 14.0               |
| TSR, minimum percent  | 75                 | 75                 |

\* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

\*\* Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

#### 2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory JMF design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4

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percent voids total mix (VTM).

TABLE 4. Field (Plant) Established JMF Tolerances  
Sieves                      Adjustments (plus or minus), percent

|                |      |
|----------------|------|
| 1/2 inch       | 3    |
| No. 4          | 3    |
| No. 8          | 3    |
| No. 200        | 1    |
| Binder Content | 0.40 |

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; while not desirable, this is acceptable, except for the No. 200 sieve, which shall remain within the aggregate grading of Table 2.

#### 2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02 and AI MS-22. The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

##### 2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

##### 2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the dynamic shear rheometer at high temperature and bending beam at low temperature requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

#### PART 3 EXECUTION

Construction of Hot Mix Asphalt Roads shall conform to ODOT Standard Specification Section 401.

##### 3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Performance-Graded (PG) asphalts shall be within the temperature range of 70-72 degrees F when added to the aggregate.

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### 3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

### 3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

### 3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat and/or tack coat shall be applied in accordance with the contract specifications.

### 3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The Contractor shall construct a test section 250 - 500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same thickness as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

#### 3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost

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to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 5. Test Section Requirements for Material and Mixture Properties

| <u>Property</u>  | <u>Specification Limit</u> |
|--|----------------------------|
| Aggregate Gradation-Percent Passing (Individual Test Result) |                            |
| No. 4 and larger   | JMF plus or minus 8        |
| No. 8, No. 16, No. 30, and No. 50                            | JMF plus or minus 6        |
| No. 100 and No. 200  | JMF plus or minus 2.0      |
| Asphalt Content, Percent<br>(Individual Test Result)         | JMF plus or minus 0.5      |
| Laboratory Air Voids, Percent<br>(Average of 3 specimens)    | JMF plus or minus 1.0      |
| VMA, Percent (Average of 3 specimens)                        | 14 minimum                 |
| Stability, pounds (Average of 3 specimens)                   | 1800 minimum               |
| Flow, 0.01 inches (Average of 3 specimens)                   | 8 - 18                     |
| Mat Density, Percent of TMD<br>(Average of 4 Random Cores)   | 92.0 - 96.0                |
| Joint Density, Percent of TMD<br>(Average of 4 Random Cores) | 90.5 - 92.5                |

### 3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

### 3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. The Government will inspect the laboratory equipment and test procedures prior to the start of hot mix operations for conformance to ASTM D 3666. The laboratory shall maintain the Corps certification for the duration of the project. A statement signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The statement shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.

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- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

### 3.7 TRANSPORTING AND PLACING

#### 3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver.

#### 3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

### 3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way



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defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

### 3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

#### 3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

#### 3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

### 3.10 CONTRACTOR QUALITY CONTROL

#### 3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures

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- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness

### 3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. The laboratory shall meet the requirements as required in ASTM D 3666. Laboratory facilities shall be kept clean and all equipment maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

### 3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

#### 3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE) by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with ASTM D 6307, or the nuclear method in accordance with ASTM D 4125. Calibrate the ignition oven or the nuclear gauge for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

#### 3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the ignition oven or nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

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#### 3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

#### 3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

#### 3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

#### 3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 50 blows per side with the hand-held Marshall hammer as described in ASTM D 6926. Hot-mix provided under the ODOT Standard Specifications option shall be compacted in accordance with the DOT requirements. After compaction, the laboratory air voids of each specimen shall be determined. Stability and flow shall be determined for the Marshall-compacted specimens, in accordance with ASTM D 6927.

#### 3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

#### 3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE.

#### 3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

#### 3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

#### 3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

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### 3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

| Parameter to be Plotted  | Running Average of<br>Individual Samples |                     | Last Four Samples |                     |
|--|--|---------------------|-------------------|---------------------|
|  | Action<br>Limit                          | Suspension<br>Limit | Action<br>Limit   | Suspension<br>Limit |
| No. 4 sieve, Cumulative %<br>Passing, deviation from JMF<br>target; plus or minus values   | 6  | 8                   | 4                 | 5                   |
| No. 30 sieve, Cumulative %<br>Passing, deviation from JMF<br>target; plus or minus values  | 4  | 6                   | 3                 | 4                   |
| No. 200 sieve, Cumulative %<br>Passing, deviation from JMF<br>target; plus or minus values | 1.4                                      | 2.0                 | 1.1               | 1.5                 |
| Stability, pounds (minimum)  |  |                     |                   |                     |
| 75 Blow JMF  | 1800                                     | 1700                | 1900              | 1800                |
| 50 Blow JMF  | 1000                                     | 900                 | 1100              | 1000                |
| Flow, 0.01 inches  |  |                     |                   |                     |
| 75 Blow  | 8 min.                                   | 7 min.              | 9 min.            | 8 min.              |
|  | 16 max.                                  | 17 max.             | 15 max.           | 16 max.             |
| 50 Blow  | 8 min.                                   | 7 min.              | 9 min.            | 8 min.              |
|  | 18 max.                                  | 19 max.             | 17 max.           | 18 max.             |
| Asphalt content, % deviation<br>from JMF target; plus or minus                             | 0.4                                      | 0.5                 | 0.2               | 0.3                 |

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Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

| Parameter to be Plotted                                       | Running Average of<br>Individual Samples   |                     | Last Four Samples |                     |
|---|--|---------------------|-------------------|---------------------|
|   | Action<br>Limit  | Suspension<br>Limit | Action<br>Limit   | Suspension<br>Limit |
| -----<br>value  |  |                     |                   |                     |
| Laboratory Air Voids, %<br>deviation from JMF target<br>value | No specific action and suspension<br>limits set since this parameter is<br>used to determine percent payment |                     |                   |                     |
| In-place Mat Density,<br>% of TMD                             | No specific action and suspension<br>limits set since this parameter is<br>used to determine percent payment |                     |                   |                     |
| In-place Joint Density,<br>% of TMD                           | No specific action and suspension<br>limits set since this parameter is<br>used to determine percent payment |                     |                   |                     |

### 3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Test results and payment calculations shall be forwarded daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 short tons 8 hours of production or one day's production. Acceptance for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

#### 3.11.1 Acceptance

When a lot of material fails to meet the specification requirements for acceptance as outlined in the following paragraphs, that lot shall be removed and replaced.

#### 3.11.2 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with

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ASTM D 6926. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

### 3.11.3 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

### 3.11.4 Laboratory Air Voids and Theoretical Maximum Density

Laboratory air voids will be calculated by determining the Marshall or Superpave density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method of ASTM D 2726 and determining the theoretical maximum density of every other subplot sample using ASTM D 2041. Laboratory air void calculations for each subplot will use the latest theoretical maximum density values obtained, either for that subplot or the previous subplot. The mean absolute deviation of the four laboratory air void contents (one from each subplot) from the JMF air void content will be evaluated and a pay factor determined from Table 7. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

### 3.11.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each subplot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

$$\text{Mean Absolute Deviation} = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4$$

$$= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 7 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 7. Acceptance Based on Laboratory Air Voids  
Mean Absolute Deviation of Lab Air Voids from JMF Pay Factor, %

|              |        |
|--------------|--------|
| 1.00 or less | Accept |
| Above 1.01   | Reject |

### 3.11.6 In-place Density

#### 3.11.6.1 General Density Requirements

For determining in-place density, one random core ( 4 inches or 6 inches in diameter) will be taken by the Contractor in the presence of the Contracting Officer from the mat (interior of the lane) of each subplot, and one random core will be taken from the joint (immediately over joint) of

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each subplot. Each random core will be full thickness of the layer being placed. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

### 3.11.6.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average TMD for the lot. The TMD for each lot will be determined as the average TMD of the two random samples per lot. The average in-place mat density and joint density for a lot are determined and compared with Table 8 to determine acceptance per lot based on in-place density, as described below. The area associated with the joint is then determined and will be considered to be 5 feet wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. Acceptance for the joint is determined based on this percentage (see example below). The acceptance for mat density and acceptance for joint density are verified. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD will be used as the TMD needed to calculate the percent joint density. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 8. Acceptance Based on In-place Density

| Average Mat Density<br>(4 Cores) | Pay Factor, % | Average Joint Density<br>(4 Cores) |
|----------------------------------|---------------|------------------------------------|
| -----                            |               |                                    |
| 92.7 to 96.7                     | Accept        | 94-97                              |
| Below 92.6 or above 96.7         | Reject        | Below 94 or above 97               |

### 3.11.6.3 Acceptance Based on In-place Density

An example of the computation of a pay factor (in I-P units only) based on in-place density, is as follows: Assume the following test results for field density made on the lot: (1) Average mat density = 93.2 percent of TMD. (2) Average joint density = 91.0 percent of TMD. (3) Total area of lot = 30,000 square feet. (4) Length of completed longitudinal construction joint = 2000 feet.

a. Step 1: Determine Acceptance based on mat density and on joint density, using Table 8:

Mat density of 93.2 percent = Acceptance.

Joint density of 91.0 percent = Rejected.

Mat density: Accepted. Joint density: Rejected

Remove and replace entire lot based on failed joint density.

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### 3.11.7 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, the Contractor shall test the final wearing surface of the pavement for conformance with the specified plan grade. In areas where the grade exceeds the tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

### 3.11.8 Surface Smoothness

The Contractor shall use the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

#### 3.11.8.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances of 1/4 inch in both the longitudinal and transverse directions, when tested with an approved 12 feet straightedge.

#### 3.11.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Each lot of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 20 feet wide and at the third points for lanes 20 feet or wider. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface



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irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

#### 3.11.8.3 Acceptance for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.3 inch in height shall be reduced by diamond grinding until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

-- End of Section --

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SECTION 32 13 14

CONCRETE PAVEMENTS FOR SMALL PROJECTS  
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

|           |   |
|-----------|---|
| ACI 211.1 | (1991; R 2002) Standard Practice for<br>Selecting Proportions for Normal,<br>Heavyweight, and Mass Concrete |
| ACI 301   | (2005) Specifications for Structural<br>Concrete for Buildings  |
| ACI 305R  | (1999) Hot Weather Concreting   |

ASTM INTERNATIONAL (ASTM)

|                   |   |
|-------------------|---|
| ASTM A 184/A 184M | (2001) Fabricated Deformed Steel Bar Mats<br>for Concrete Reinforcement   |
| ASTM A 615/A 615M | (2005a) Deformed and Plain Billet-Steel<br>Bars for Concrete Reinforcement  |
| ASTM C 1077       | (2005a) Laboratories Testing Concrete and<br>Concrete Aggregates for Use in<br>Construction and Criteria for Laboratory<br>Evaluation |
| ASTM C 123        | (2004) Lightweight Particles in Aggregate   |
| ASTM C 143/C 143M | (2005) Slump of Hydraulic Cement Concrete   |
| ASTM C 150        | (2005) Portland Cement  |
| ASTM C 192/C 192M | (2005) Making and Curing Concrete Test<br>Specimens in the Laboratory   |
| ASTM C 231        | (2004) Air Content of Freshly Mixed<br>Concrete by the Pressure Method  |
| ASTM C 260        | (2001) Air-Entraining Admixtures for<br>Concrete  |
| ASTM C 31/C 31M   | (2003a) Making and Curing Concrete Test<br>Specimens in the Field   |
| ASTM C 33         | (2003) Concrete Aggregates  |

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|                   |   |
|-------------------|---|
| ASTM C 39/C 39M   | (2004a) Compressive Strength of Cylindrical Concrete Specimens  |
| ASTM C 494/C 494M | (2005) Chemical Admixtures for Concrete   |
| ASTM C 618        | (2005) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete                                   |
| ASTM C 666/C 666M | (2003) Resistance of Concrete to Rapid Freezing and Thawing   |
| ASTM C 881/C 881M | (2002) Epoxy-Resin-Base Bonding Systems for Concrete  |
| ASTM C 94/C 94M   | (2004a) Ready-Mixed Concrete  |
| ASTM C 989        | (2005) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars   |
| ASTM D 1751       | (2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

|                |                                 |
|----------------|---------------------------------|
| NRMCA CPMB 100 | (2000) Concrete Plant Standards |
|----------------|---------------------------------|

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

|             |                                   |
|-------------|-----------------------------------|
| Section 401 | General Requirements for Surfaces |
| Section 701 | Portland Cement Concrete          |

U.S. ARMY CORPS OF ENGINEERS (USACE)

|               |  |
|---------------|--|
| COE CRD-C 130 | (2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles |
| COE CRD-C 300 | (1990) Specifications for Membrane-Forming Compounds for Curing Concrete                           |

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete (rigid) pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.3 ACCEPTABILITY OF WORK

The pavement will be accepted on the basis of tests made by the Government and by the Contractor or its suppliers, as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing. Concrete samples shall be taken by the Contractor at the placement to determine the slump, air content, and

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strength of the concrete. Test cylinders shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed into service. All air content measurements shall be determined in accordance with ASTM C 231. All slump tests shall be made in accordance with ASTM C 143/C 143M. All test cylinders shall be 6 by 12 inch cylinders and shall be fabricated in accordance with ASTM C 192/C 192M, using only steel molds, cured in accordance with ASTM C 31/C 31M, and tested in accordance with ASTM C 39/C 39M. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory.

#### 1.3.1 Evaluation Sampling

Sampling, testing, and mixture proportioning shall be performed by a commercial Testing Laboratory, conforming with ASTM C 1077. The individuals who sample and test concrete and concrete constituents shall be certified as American Concrete Institute (ACI) Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete shall be certified as ACI Concrete Construction Inspector, Level II. All mix design, weekly quality control reports, smoothness reports, and project certification reports shall be signed by a Registered Engineer.

#### 1.3.2 Surface Testing

Surface testing for surface smoothness and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

##### 1.3.2.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 1 when checked with the straightedge.

TABLE 1  
STRAIGHTEDGE SURFACE SMOOTHNESS--PAVEMENTS

| Pavement Category<br>-----                            | Direction<br>of Testing<br>----- | Tolerances<br>inches<br>----- |
|---|----------------------------------|-------------------------------|
| Roads and Streets                                     | Longitudinal                     | 3/16                          |
|   | Transverse                       | 1/4                           |
| Tank Hardstands, Parking<br>Areas, Open Storage Areas | Longitudinal                     | 1/4                           |
|   | Transverse                       | 1/4                           |

##### 1.3.2.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to

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identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

#### 1.3.3 Plan Grade Testing and Conformance

The finished surface of the pavements shall conform, within the tolerances shown in Table 1, to the lines, grades, and cross sections shown. The finished surface of new abutting pavements shall coincide at their juncture. The finished surface of airfield runway, taxiway, and apron pavements shall vary not more than 0.04 foot above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

#### 1.4 PRECONSTRUCTION TESTING OF MATERIALS

The Contractor shall not be entitled to any additional payment or extension of time because of delays caused by sampling and testing additional sources, or samples, necessitated by failure of any samples. Aggregates shall be sampled and tested by the Test Laboratory and shall be representative of the materials to be used for the project. Test results, signed by a Registered Engineer, shall be submitted 30 days before commencing paving. No aggregate shall be used unless test results show that it meets all requirements of these specifications, including compliance with ASTM C 33 and deleterious materials limitations.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-03 Product Data

##### Equipment

Manufacturer's literature on the concrete plant; mixing equipment; hauling equipment; placing and finishing, and curing equipment; at least 7 days prior to start of paving.

##### Paving

Paving Schedules at least 7 days prior to start of paving.

##### Mixture Proportions; G

The report of the Contractor's mixture proportioning studies

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showing the proportions of all ingredients and supporting information on aggregate and other materials that will be used in the manufacture of concrete, at least 14 days prior to commencing concrete placing operations.

## 1.6 EQUIPMENT

### 1.6.1 Batching and Mixing

The batching plant shall conform to NRMCA CPMB 100, the equipment requirements in ASTM C 94/C 94M, and as specified. Water shall not be weighed or measured cumulatively with another ingredient. All concrete materials batching shall meet ASTM C 94/C 94M requirements. Mixers shall be stationary mixers or truck mixers. Batching, mixers, mixing time, permitted reduction of mixing time, and concrete uniformity shall meet the requirements of ASTM C 94/C 94M, and shall be documented in the initial weekly QC Report.

### 1.6.2 Transporting Equipment

Transporting equipment shall be in conformance with ASTM C 94/C 94M and as specified herein. Concrete shall be transported to the paving site in rear-dump trucks, in truck mixers designed with extra large blading and rear opening specifically for low slump concrete, or in agitators. Bottom-dump trucks shall not be used for delivery of concrete.

### 1.6.3 Delivery Equipment

When concrete transport equipment cannot operate on the paving lane, side-delivery transport equipment consisting of self-propelled moving conveyors shall be used to deliver concrete from the transport equipment and discharge it in front of the paver. Front-end loaders, dozers, or similar equipment shall not be used to distribute the concrete.

### 1.6.4 Paver-Finisher with Fixed Forms

The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and to spread the preventing deformation of the forms.

#### 1.6.4.1 Other Types of Finishing Equipment

Clary screeds or other rotating tube floats will not be allowed on the project.

### 1.6.5 Curing Equipment

Equipment for curing is specified in paragraph CURING.

### 1.6.6 Texturing Equipment

Texturing equipment shall be as specified below.

#### 1.6.6.1 Fabric Drag

A fabric drag shall consist of a piece of fabric material as wide as the lane width securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. The material shall be wide enough to provide 12 to 18 inches dragging flat on

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the pavement surface. The fabric material shall be clean, reasonably new burlap, kept clean and saturated during use. The fabric material may be an artificial turf fabricated of a plastic material.

#### 1.6.6.2 Deep Texturing Equipment

Texturing equipment shall consist of a stiff bristled broom forming a drag at least 4 feet long. This drag shall be mounted in a wheeled frame spanning the paving lane and constructed to mechanically pull the drag in a straight line across the paving lane perpendicular to the centerline.

#### 1.6.7 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-tip-bladed concrete saws mounted on a wheeled chassis.

#### 1.6.8 Straightedge

The Contractor shall furnish and maintain at the job site one 12 foot straightedge for testing concrete surface smoothness. The straightedge shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

### PART 2 PRODUCTS

#### 2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement and pozzolan and shall conform to appropriate specifications listed below.

##### 2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type II, low-alkali.

##### 2.1.2 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618 Class F, including all the supplementary optional physical requirements. Fly ash shall conform to EPA requirements in accordance with Section 01 67 00 RECYCLED / RECOVERED MATERIALS.

##### 2.1.3 Slag

ASTM C 989, Ground Granulated Blast Furnace Slag (GGBFS), Grade 100 or 120. Certificates shall include test results in accordance with ASTM C 989.

#### 2.2 AGGREGATES

Aggregates shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33, including deleterious materials, abrasion loss and soundness requirements of ASTM C 33, and other requirements specified herein. Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing in concrete in accordance with ASTM C 666/C 666M.

In addition to the grading requirements specified for coarse aggregate and for fine aggregate, the combined aggregate grading shall meet the following

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requirements.

- a. If necessary, a blending aggregate shall be used to meet the required combined grading. This blending aggregate shall be batched separately. The combined grading of all aggregates used, in the proportions selected, shall be computed on the basis of cumulative percent retained on each sieve specified for fine and coarse aggregate.
- b. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (W) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.
- c. The Coarseness Factor (CF) shall be determined from the following equation:

$$CF = (\text{cumulative percent retained on the } 3/8 \text{ in. sieve}) (100) / (\text{cumulative percent retained on the No. 8 sieve})$$

The Workability Factor (W) is defined as the cumulative percent passing the No. 8 sieve. However, W shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic yard greater than 564 pounds per cubic yard.

- d. A diagram shall be plotted using a rectangular scale with W on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, W-28), (CF-75, W-40), (CF-45, W-32.5), and (CF-45, W-41). If the point determined by the intersection of the computed CF and W does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.
- e. In addition, the individual percent retained on each sieve shall be plotted for the combined aggregate grading, on either rectangular or semi-log graph paper. The graph shall show a relative smooth transition between coarse and fine aggregate and shall have no major valleys or peaks in the area smaller than the No. 8 sieve. If this plot does not meet the above criteria, the grading of each size aggregate used and the proportions selected shall be changed as necessary.

#### 2.2.1 Coarse Aggregate

Coarse aggregate shall consist of crushed gravel, crushed stone, or a combination thereof in accordance with ODOT Standard Specification Section 701.06, size 57 stone. The nominal maximum size of the coarse aggregate shall be 3/4 inches. When the nominal maximum size is greater than 1 inch, the aggregates shall be furnished in two ASTM C 33 size groups, No. 67 and No. 4. The amount of deleterious material in each size of coarse aggregate shall not exceed the limits shown in ASTM C 33 Class 1N, 4M or 4S, depending on the weathering region, and the following limits:

- a. Lightweight particles 1.0 max. percent by mass (ASTM C 123).
- b. Other soft particles 2.0 max. percent by mass (COE CRD-C 130).



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- c. Total of all deleterious 5.0 max. percent by mass (substances listed in ASTM C 33 and above, exclusive of material finer than No. 200 sieve).
- d. The separation medium for lightweight particles shall have a density of Sp. Gr. of 2.0.

#### 2.2.2 Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles in accordance with ODOT Standard Specification Section 701.05. All fine aggregate shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33 and the requirements herein. The amount of deleterious material in the fine aggregate shall not exceed the limits in ASTM C 33 and shall not exceed the following limits:

- a. Lightweight particles (ASTM C 123) 1.0 percent max. by mass using a medium with a density of Sp. Gr. of 2.0.
- b. The total of all deleterious material types, listed in ASTM C 33 and above, shall not exceed 3.0 percent of the mass of the fine aggregate.

#### 2.3 CHEMICAL ADMIXTURES

Air-entraining admixture shall conform to ASTM C 260. An accelerator shall be used only when specified in paragraph SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES and shall not be used to reduce the amount of cementitious material used. Accelerator shall conform to ASTM C 494/C 494M Type C. Calcium chloride and admixtures containing calcium chloride shall not be used. A water-reducing or retarding admixture shall meet the requirements of ASTM C 494/C 494M. Type G or H admixtures are not allowed.

#### 2.4 CURING MATERIALS

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. Burlap shall be new or shall be clean material never used for anything other than curing concrete.

#### 2.5 WATER

Water for mixing and curing shall be clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, in accordance with ODOT Standard Specification Section 701.04.

#### 2.6 JOINT MATERIALS

##### 2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D 1751. Expansion joint filler shall be 3/4 inch thick.

#### 2.7 REINFORCING

##### 2.7.1 General

Reinforcing bars shall conform to ASTM A 615/A 615M Grade 60. Bar mats shall conform to ASTM A 184/A 184M. Reinforcement shall be free from

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loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete.

## 2.8 DOWELS AND TIE BARS

### 2.8.1 Dowels

Dowels shall be single piece, plain (non-deformed) steel bars conforming to ASTM A 615/A 615M Grade 60 or higher. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight.

### 2.8.2 Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A 615/A 615M Grade 60. Grade 60 or higher shall not be used for bars that are bent and straightened during construction.

## 2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to ASTM C 881/C 881M, Class as appropriate for each application temperature to be encountered; except, that in addition, the materials shall meet the following requirements:

- a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.
- b. Material for use as patching for complete filling of spalls, wide cracks, and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.
- c. Material for injecting cracks shall be Type IV, Grade 1.
- d. Material for bonding freshly mixed portland cement concrete, mortar, or freshly mixed epoxy resin concrete to hardened concrete shall be Type V, Grade as approved.

## 2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

Specified compressive strength,  $f'_c$ , for concrete is 4000 psi at 28 days in accordance with ODOT Standard Specifications Section 701, Type AA. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio is based on absolute volume equivalency, where the ratio is determined using the weight of cement for a cement only mix, or using the total volume of cement plus pozzolan converted to an equivalent weight of cement by the absolute volume equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 6 plus or minus 1.5 percent. The maximum allowable slump of the concrete shall be 3 inches for pavement constructed with fixed forms. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'_c$  and no individual test result falls below the specified strength  $f'_c$  by more than 500 psi. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

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## 2.11 MIXTURE PROPORTIONS

### 2.11.1 Composition Concrete

Composition concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Fly ash, if used, shall be used only at a rate between 15 and 35 percent by mass of the total cementitious material. Admixtures shall consist of air entraining admixture and may also include water-reducing admixture. High range water-reducing admixtures and admixtures to produce flowable concrete shall not be used. No substitutions shall be made in the materials used in the mixture proportions without additional tests to show that the quality of the concrete is satisfactory.

### 2.11.2 Concrete Mixture Proportioning Studies

Trial design batches, mixture proportioning studies, and testing shall be the responsibility of the Contractor, and shall be performed by the Test Laboratory and signed by a Registered Engineer. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions. All materials used in mixture proportioning studies shall be representative of those proposed for use on the project. If there is a change in materials, additional mixture design studies shall be made using the new materials. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1. At least three different water-cementitious ratios, which will produce a range of strength encompassing that required on the project, shall be used. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content. Maximum sand content shall be 40 percent of the total aggregate SSD weight. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

### 2.11.3 Mixture Proportioning Procedure

The Contractor shall perform the following:

- a. Fabricate, cure and test 6 test cylinders per age for each mixture at 7 and 28 days.
- b. Using the average strength for each  $w/(c+p)$ , plot the results from each of the three mixtures on separate graphs for  $w/(c+p)$  versus 28-day strength.
- c. From the graphs select a  $w/(c+p)$  which will produce a mixture giving a 28-day strength equal to the required strength determined in accordance with the following paragraph.

### 2.11.4 Average Strength Required for Mixtures

In order to ensure meeting, during production, the strength requirements specified, the mixture proportions selected shall produce a required average strength,  $f'_{cr}$ , exceeding the specified strength,  $f'_c$ , in accordance with procedures in Chapter 3 of ACI 301, "Proportioning."

## PART 3 EXECUTION

### 3.1 CONDITIONING OF UNDERLYING MATERIAL

Construction of concrete pavements shall conform to ODOT Standard

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#### Specification Section 401.

Underlying material, subgrade or base course, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon.

### 3.2 WEATHER LIMITATIONS

#### 3.2.1 Hot Weather Paving

The temperature of concrete shall not exceed 90 degrees F. Steel forms, dowels and reinforcing shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Follow practices found in ACI 305.

#### 3.2.2 Cold Weather Paving

The ambient temperature of the air at the placing site and the temperature of surfaces to receive concrete shall be not less 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used at any time. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Follow practices found in ACI 305. Pavement damaged by freezing shall be completely removed and replaced at the Contractor's expense as specified in paragraph, REPAIR, REMOVAL, AND REPLACEMENT OF SLABS.

### 3.3 CONCRETE PRODUCTION

#### 3.3.1 General Requirements

Concrete shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall show at least the mass, or volume, of all ingredients in each batch delivered, and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government daily.

#### 3.3.2 Transporting and Transfer-Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. No equipment shall be allowed to operate on the prepared and compacted underlying material in front of the paver-finisher. Additional water may be added to truck mixers to bring the slump within the specified range provided the mixture water-cement ratio is not exceeded.

### 3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms.

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#### 3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

#### 3.4.2 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

#### 3.4.3 Required Results

The paver-finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

#### 3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms for overlay pavements and for other locations where forms must be set on existing pavements shall be held securely in place with stakes or by other approved methods. Holes in existing pavements for form stakes shall be carefully drilled without cracking or spalling the existing pavement. Prior to setting forms for paving operations, the Contractor shall demonstrate the proposed form setting procedures at an approved location and shall not proceed further until the proposed method is approved. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

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#### 3.4.5 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement, or may be placed on an initial layer of consolidated concrete, with the subsequent layer placed within 30 minutes of the first layer placement.

#### 3.4.6 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels and tie bars in joints shall be omitted when the center of the dowel or tie bar is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

##### 3.4.6.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels and tie bars shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

##### 3.4.6.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

##### 3.4.6.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

##### 3.4.6.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

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### 3.5 FINISHING

Clary screeds, "bridge deck" finishers, or other rotating pipe or tube type equipment shall not be permitted. The sequence of machine operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Hand finishing shall be used only infrequently and only on isolated areas of odd slab shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Equipment to be used for supplemental hand finishing shall primarily be 10 to 12 feet cutting straightedges; only very sparing use of bull floats shall be allowed. At no time shall water be added to the surface of the slab in any way, except for fog (mist) sprays to prevent plastic shrinkage cracking.

#### 3.5.1 Machine Finishing With Fixed Forms

The machine shall be designed to ride the forms. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

#### 3.5.2 Surface Correction

While the concrete is still plastic, irregularities and marks in the pavement surface shall be eliminated by means of cutting straightedges, 10 to 12 feet in length. Depressions shall be filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. Long-handled, flat "bull floats" shall be used sparingly and only as necessary to correct minor, scattered surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished.

#### 3.5.3 Hand Finishing

Hand finishing operations shall be used only for those unusual slabs as specified previously. Grate tampers (jitterbugs) shall not be used. As soon as placed and vibrated, the concrete shall be struck off and screeded. The surface shall be tamped with a strike-off and tamping screed, or vibratory screed. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally. Long-handled, flat bull floats shall be used sparingly and only as necessary to correct surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished. No water shall be added to the pavement during finishing operations.

#### 3.5.4 Texturing

##### 3.5.4.1 Broom Texturing

Surface texture shall be applied using a mechanical stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line. The broom shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the

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minimum necessary to obtain a uniformly textured surface. The scores should be uniform in appearance and approximately 1/16 inch in depth but not more than 1/8 inch in depth. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted.

#### 3.5.4.2 Burlap Drag Finish

Before concrete becomes non-plastic, finish the surface of the slab by dragging on the surface a strip of clean, wet burlap measuring from 3 to 10 feet long and 2 feet wider than the width of the pavement. Select dimension of burlap drag so that at least 3 feet of the material is in contact with the pavement. Drag the surface so as to produce a finished surface with a fine granular or sandy texture without leaving disfiguring marks.

### 3.6 CURING

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. Unhardened concrete shall be protected from rain and flowing water. During hot weather with low humidity and/or wind, the Contractor shall institute measures to prevent plastic shrinkage cracks from developing. ACI 305R contains means of predicting plastic shrinkage cracking and preventative measures. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry. Curing shall be accomplished by one of the following methods.

#### 3.6.1 Membrane Curing

A uniform coating of white-pigmented membrane-forming curing compound shall be applied to the entire exposed surface of the concrete including pavement edges as soon as the free water has disappeared from the surface after finishing. If evaporation is high and no moisture is present on the surface even though bleeding has not stopped, fog sprays shall be used to keep the surface moist until setting of the cement occurs. Curing compound shall then be immediately applied. Curing compound shall be applied to the finished surfaces by means of a self-propelled automatic spraying machine, equipped with multiple spraying nozzles with wind shields, spanning the newly paved lane. The curing compound shall be applied at a maximum application rate of 200 square feet per gallon. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities. Areas where the curing compound develops the above defects or is damaged by heavy rainfall, sawing or other construction operations within the curing period, shall be immediately resprayed.

### 3.7 JOINTS

No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Design District Pavement or Geotechnical Engineer. All joints shall be straight, perpendicular to the finished grade of the pavement, and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch.



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### 3.7.1 Longitudinal Construction Joints

Dowels shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated.

### 3.7.2 Transverse Construction Joints

Transverse construction joints shall be installed at a planned transverse joint, at the end of each day's placing operations and when concrete placement is interrupted. Transverse construction joints shall be constructed either by utilizing headers and hand placement and finishing techniques, or by placing concrete beyond the transverse construction joint location and then saw cutting full depth and removing concrete back to the transverse construction joint location. For the latter case, dowels shall be installed using methods for dowels installed in hardened concrete described above. All transverse construction joints shall be dowelled.

### 3.7.3 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using preformed joint filler of the type, thickness, and width indicated, and shall extend the full slab depth. Edges of the concrete at the joint face shall be edged. The joint filler strips shall be installed to form a recess at the pavement surface to be filled with joint sealant. Expansion joints shall be constructed with dowels or thickened edges for load transfer.

### 3.7.4 Contraction Joints

Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints.

#### 3.7.4.1 Sawed Joints

Sawed contraction joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the indicated depth. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Sawing at a given joint location shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. The surface shall be resprayed with curing compound as soon as free water disappears. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord or backer rod before the concrete in the region of the joint is resprayed with curing compound.

### 3.7.5 Thickened Edge Joints

Underlying material in the transition area shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

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### 3.8 REPAIR, REMOVAL, AND REPLACEMENT OF SLABS

New pavement slabs that contain full-depth cracks shall be removed and replaced, as specified herein at no cost to the Government. Removal and replacement shall be full depth, shall be full width of the paving lane, and the limit of removal shall be from each original transverse joint. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require minimum 6 inch diameter cores to be drilled on the crack to determine depth of cracking. Cores shall be drilled and the hole later filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin. Drilling of cores and refilling holes shall be at no expense to the Government. Cracks that do not extend full depth of slab shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1. The Contractor shall ensure that the crack is not widened during epoxy resin injection. Where a full depth crack intersects the original transverse joint, the slab(s) containing the crack shall be removed and replaced, with dowels installed, as required below. Spalls along joints shall be repaired as specified.

#### 3.8.1 Removal and Replacement of Full Slabs

Unless there are dowels present, all edges of the slab shall be sawcut full depth. If dowels or tie bars are present along any edges, these edges shall be sawed full depth 6 inches from the edge if only keys are present, or just beyond the end of dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 1 inch of the depth of the dowel. The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. The narrow strips along keyed or doweled edges shall be carefully broken up and removed. Care shall be taken to prevent damage to the dowels or tie bars, or to concrete to remain in place. Protruding portions of dowels shall be painted and lightly oiled. The joint face below dowels shall be suitably trimmed so that there is no abrupt offset. If underbreak occurs at any point along any edge, the area shall be hand-filled with concrete, producing an even joint face from top to bottom, before replacing the removed slab. If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels or tie bars on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete. Original damaged dowels or tie bars shall be cut off flush with the joint face. All four edges of the new slab shall thus contain dowels or original tie bars. Prior to placement of new concrete, the underlying material shall be graded and recompact, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants, and coated with a double application of membrane forming curing compound as bond breaker. Placement of concrete shall be as specified for original construction. The resulting joints around the new slab shall be prepared and sealed as specified.

#### 3.8.2 Repairing Spalls Along Joints

Spalls along joints and cracks shall be repaired by first making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete. The cavity shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove

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all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The cavity shall be filled with low slump portland cement concrete or mortar, or with epoxy resin concrete or mortar. Portland cement concrete shall be used for larger spalls, those more than 1/3 cu. ft in size after removal operations; portland cement mortar shall be used for spalls between 0.03 and 1/3 cu. ft; and epoxy resin mortar or Type III, Grade 3 epoxy resin for those spalls less than 0.03 cu. ft in size after removal operations. Portland cement concretes and mortars shall be very low slump mixtures, proportioned, mixed, placed, tamped, and cured. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions, mixing, placing, tamping and curing procedures as recommended by the manufacturer. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. In lieu of sawing, spalls not adjacent to joints, and popouts, both less than 6 inches in maximum dimension, may be prepared by drilling a core 2 inches in diameter greater than the size of the defect, centered over the defect, and 2 inches deep or 1/2 inch into sound concrete, whichever is greater. The core hole shall be repaired as specified above for other spalls.

### 3.8.3 Areas Defective in Plan Grade or Smoothness

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with a surface grinding machine after the concrete is 14 days or more old. The depth of grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the specified limits, shall be removed and replaced. In pavement areas given a wire comb or tined texture, areas exceeding 25 square feet that have been corrected by rubbing or grinding shall be retextured by grooving machine sawn grooves meeting the requirements for the wire comb or tined texture. All areas in which grinding has been performed will be subject to the thickness tolerances specified in paragraph Thickness. Any grinding performed on individual slabs with excessive deficiencies shall be performed at the Contractor's own decision without entitlement to additional compensation if eventual removal of the slab is required.

### 3.9 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed as indicated and as specified in Section 02 41 00 DEMOLITION modified, and expanded as specified herein. Removal, repair and replacement shall be made as indicated and as specified in paragraph REPAIR, REMOVAL, AND REPLACEMENT OR SLABS.

### 3.10 PAVEMENT PROTECTION

The Contractor shall protect the pavement against all damage prior to final acceptance of the work. Traffic shall be excluded from the new pavement. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling equipment will be permitted on

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the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean. Special cleaning and care shall be used where Contractor's traffic uses or crosses active airfield pavement.

### 3.11 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL (CQC)

Paragraph ACCEPTABILITY OF WORK contains additional CQC requirements. The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and submit reports as specified. When, in the opinion of the Contracting Officer, the paving operation is out of control, concrete placement shall cease.

#### 3.11.1 Batch Plant Control

A daily report shall be prepared indicating checks made for scale accuracy with test weights, checks of batching accuracy, and corrective action taken prior to and during placement for weighing or batching, type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water masses per cubic yd, amount of water as free moisture in each size of aggregate, and the batch aggregate and water masses per cubic yd for each class of concrete batched during each day's plant operation.

#### 3.11.2 Concrete Mixture

- a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two other tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of paving. Whenever air content reaches specified limits, an immediate confirmatory test shall be made. If the second test also shows air content at or exceeding specified limits, an adjustment shall immediately be made in the amount of air-entraining admixture batched to bring air content within specified limits. If the next adjusted batch of concrete is not within specified limits, concrete placement shall be halted until concrete air content is within specified limits.
- b. Slump Testing. Slump tests shall be made when test specimens are fabricated. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Whenever slump approaches the maximum limit, an adjustment shall immediately be made in the batch masses of water and fine aggregate, without exceeding the maximum  $w/(c+p)$ . When a slump result exceeds the specification limit, no further concrete shall be delivered to the paving site until adjustments have been made and slump is again within the limit.
- c. Temperature. The temperature of the concrete shall be measured when strength specimens are fabricated.
- d. Concrete Strength Testing. Four (4) cylinders from the same batch shall be fabricated, cured and tested for compressive strength, testing two cylinders at 7-day and two cylinders at 28-day age. A minimum of one set of four (4) cylinders shall be fabricated, cured and tested for each shift of concrete placement. Control

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charts for strength, showing the 7-day and 28-day CQC compressive strengths, and the 28-day required compressive strength, shall be maintained and submitted with weekly CQC Reports.

### 3.11.3 Inspection Before Placing

Underlying materials, joint locations and types, construction joint faces, forms, reinforcing, dowels, and embedded items shall be inspected by a Registered Engineer in sufficient time prior to each paving operation in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing, and the certification signed by the Registered Engineer, prior to each days' paving.

### 3.11.4 Paving Operations

The placing foreman shall supervise all placing and paving operations, shall determine that the correct quality of concrete is placed in each location as shown, shall insure that the concrete is consolidated full depth and that finishing is performed as specified. The placing foreman shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume of concrete placed, and method of paving and any problems encountered.

### 3.11.5 Curing Inspection

- a. Moist Curing Inspections. Each day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded. When any inspection finds an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for the area shall be extended by 1 day.
- b. Membrane Curing Inspection. At the end of each day's placement, the CQC Representative shall determine the quantity of compound used by measurement of the container; shall determine the area of concrete surface covered; shall then compute the rate of coverage in square feet per gallon and shall also note whether or not coverage is uniform. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

### 3.11.6 Cold-Weather Protection

At least once per day, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

### 3.11.7 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report, signed by a registered engineer, shall be prepared for the updating of control charts and test data, and all CQC inspections and actions covering the entire period from the start of the construction through the current week. Reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all CQC records. A copy of weekly reports shall be faxed to the Design

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District Pavement or Geotechnical Engineer. At the completion of concrete placement, a certification report shall be prepared containing mix designs, all updated control charts and concrete test data, quality control reports, smoothness reports, and other pertinent data on the concrete, with a certification by a registered engineer that the concrete placed meets all specification requirements. A copy of the certification report shall be mailed to the Design District pavement or Geotechnical Engineer.

-- End of Section --



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SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 305R (1999) Hot Weather Concreting

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 182 (2005) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

ASTM A 185 (2002) Steel Welded Wire Reinforcement,  
Plain, for Concrete

ASTM A 615/A 615M (2005a) Deformed and Plain Billet-Steel  
Bars for Concrete Reinforcement

ASTM C 143/C 143M (2005) Slump of Hydraulic Cement Concrete

ASTM C 171 (2003) Sheet Materials for Curing Concrete

ASTM C 172 (2004) Sampling Freshly Mixed Concrete

ASTM C 173/C 173M (2001e1) Air Content of Freshly Mixed  
Concrete by the Volumetric Method

ASTM C 231 (2004) Air Content of Freshly Mixed  
Concrete by the Pressure Method

ASTM C 309 (2003) Liquid Membrane-Forming Compounds  
for Curing Concrete

ASTM C 31/C 31M (2003a) Making and Curing Concrete Test  
Specimens in the Field

ASTM C 920 (2005) Elastomeric Joint Sealants

ASTM D 1751 (2004) Preformed Expansion Joint Filler  
for Concrete Paving and Structural  
Construction (Nonextruding and Resilient  
Bituminous Types)

ASTM D 1752 (2004a) Preformed Sponge Rubber and Cork  
Expansion Joint Fillers for Concrete



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## Paving and Structural Construction

ASTM D 5893

(2004) Cold Applied, Single Component,  
Chemically Curing Silicone Joint Sealant  
for Portland Cement Concrete Pavements

### OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD CONSTRUCTION SPECIFICATIONS

Section 509

Structural Concrete

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-03 Product Data

#### Concrete

Copies of certified delivery tickets for all concrete used in the construction.

### SD-06 Test Reports

#### Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

## 1.3 WEATHER LIMITATIONS

### 1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point and shall be in accordance with ACI 305R. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

### 1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F

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except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time. Placing shall be in accordance with ACI 305R.

#### 1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

##### 1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

##### 1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

#### PART 2 PRODUCTS

##### 2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 32 13 14 CONCRETE PAVEMENTS FOR SMALL PROJECTS or ODOT Standard Specification Section 509 except as otherwise specified. Concrete shall have a minimum compressive strength of 4000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

##### 2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

##### 2.1.2 Slump

The concrete slump shall be 3 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

##### 2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185.

##### 2.2 CONCRETE CURING MATERIALS

##### 2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

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#### 2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

#### 2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

### 2.3 JOINT FILLER STRIPS

#### 2.3.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

#### 2.3.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

### 2.4 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D 5893.

### 2.5 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

#### 2.5.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

#### 2.5.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch

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benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

### PART 3 EXECUTION

#### 3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 31 00 00 EARTHWORK.

##### 3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

##### 3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

##### 3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

#### 3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

##### 3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

##### 3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours

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nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

### 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

#### 3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

#### 3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

#### 3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

#### 3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

### 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

#### 3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

#### 3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

#### 3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces

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shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

#### 3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

#### 3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

### 3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

#### 3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

#### 3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied

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joint sealant. Joint sealant shall be gray or stone in color. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

### 3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

### 3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

#### 3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

#### 3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

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### 3.7 CURING AND PROTECTION

#### 3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

##### 3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

##### 3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

##### 3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete



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in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

### 3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

### 3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

### 3.7.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

#### 3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

#### 3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

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### 3.8 FIELD QUALITY CONTROL

#### 3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

#### 3.8.2 Concrete Testing

##### 3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

##### 3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173/C 173M or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

##### 3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

#### 3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

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#### 3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

### 3.9 SURFACE DEFICIENCIES AND CORRECTIONS

#### 3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

#### 3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

#### 3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

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## SECTION 32 92 19

### SEEDING

04/06

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM INTERNATIONAL (ASTM)

ASTM D 4972 (2001) pH of Soils

##### OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS

Section 232 Seeding

Section 234 Fertilizing and Agricultural Liming

Section 735 Material for Roadside Development and  
Erosion Control

##### U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

DOA SSIR 42 (1996) Soil Survey Investigation Report  
No. 42, Soil Survey Laboratory Methods  
Manual, Version 3.0

##### 1.2 DEFINITIONS

###### 1.2.1 Stand of Turf

95 percent ground cover of the established species.

##### 1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 96 00 TRANSPLANTING EXTERIOR PLANTS, Section 32 92 23 SODDING, Section 32 93 00 EXTERIOR PLANTS, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

##### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

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Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

#### SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

#### SD-07 Certificates

State certification and approval for seed

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### 1.5.1 Delivery

##### 1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

##### 1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

#### 1.5.2 Storage

##### 1.5.2.1 Seed and Fertilizer Storage

Store in cool, dry locations away from contaminants.

##### 1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

##### 1.5.2.3 Handling

Do not drop or dump materials from vehicles.

### 1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

#### 1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

### 1.7 TIME LIMITATIONS

#### 1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

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## PART 2 PRODUCTS

### 2.1 SEED

#### 2.1.1 Classification

Provide State-certified or State-approved Native Bermuda grass seed as indicated in ODOT Standard Specification Section 232 of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer.

#### 2.1.2 Planting Dates

| <u>Planting Season</u> | <u>Planting Dates</u> |
|------------------------|-----------------------|
| Spring                 | April 1 to June 1     |
| Fall                   | Sept. 30 to Nov. 30   |

#### 2.1.3 Seed Purity

As required by ODOT Standard Specification Section 232.

#### 2.1.4 Seed Mixture by Weight

Proportion seed mixtures by weight. Temporary seeding must later be replaced by plantings for a permanent stand of grass. The same requirements of turf establishment apply for temporary seeding.

### 2.2 TOPSOIL

#### 2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

#### 2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

#### 2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

|      |               |
|------|---------------|
| Silt | 25-50 percent |
|------|---------------|

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|               |                 |
|---------------|-----------------|
| Clay          | 10-30 percent   |
| Sand          | 20-35 percent   |
| pH            | 5.5 to 7.0      |
| Soluble Salts | 600 ppm maximum |

## 2.3 FERTILIZER

### 2.3.1 Granular Fertilizer

Organic or synthetic, granular controlled release fertilizer, in accordance with ODOT Standard Specification Section 735 and Section 234 containing the following minimum percentages, by weight, of plant food nutrients:

- 5 percent available nitrogen
- 10 percent available phosphorus
- 5 percent available potassium

### 2.3.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients, or as required by ODOT Standard Specification Section 234 and Section 735.

- 5 percent available nitrogen
- 10 percent available phosphorus
- 5 percent available potassium

## 2.4 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

### 2.4.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.

### 2.4.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

### 2.4.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

## 2.5 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

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## PART 3 EXECUTION

### 3.1 PREPARATION

#### 3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

##### 3.1.1.1 Topsoil

Provide 4 inches of off-site topsoil or available on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

##### 3.1.1.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 5 pounds per 1000 square feet.

Synthetic Fertilizer 5 pounds per 1000 square feet.

Hydroseeding Fertilizer 5 pounds per 1000 square feet.

### 3.2 SEEDING

#### 3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

#### 3.2.2 Seed Application Method

Seeding method shall be drill seeding or hydroseeding.

##### 3.2.2.1 Drill Seeding

Seed shall be drilled at the rate required by ODOT Standard Specification Section 232. Use grass seed drills. Drill seed uniformly to average depth of 1/2 inch.



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#### 3.2.2.2 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed shall be mixed to ensure broadcasting at the rate required by ODOT Standard Specification Section 232 and Section 735. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

#### 3.2.3 Mulching

##### 3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

#### 3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed by hydroseeding, rolling may be eliminated.

#### 3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

### 3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

### 3.4 RENOVATION OF EXISTING TURF AREA

#### 3.4.1 Aeration

Upon completion of weed eradication operations and Contracting Officer's approval to proceed, aerate turf areas indicated by an approved device. Core, by pulling soil plugs, to a minimum depth of 3 inches. Leave all soil plugs, that are produced, in the turf area.

#### 3.4.2 Overseeding

Apply seed in accordance with applicable portions of paragraph entitled "Seed Application Method" at rates in accordance with paragraph entitled "Seed Composition."

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### 3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --



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SECTION 32 92 23

SODDING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602 (2006) Agricultural Liming Materials

ASTM D 4427 (1992; R 2002e1) Peat Samples by  
Laboratory Testing

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS (1995) Guideline Specifications to  
Turfgrass Sodding

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 92 19 SEEDING, Section 32 93 00 EXTERIOR PLANTS, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations as per establishment); G.

SD-07 Certificates

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Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS; G.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

##### 1.5.1 Delivery

###### 1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

###### 1.5.1.2 Fertilizer, Gypsum, Sulfur, Iron, and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulphur, iron, and lime may be furnished in bulk with certificate indicating the above information.

##### 1.5.2 Storage

###### 1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

###### 1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

###### 1.5.2.3 Handling

Do not drop or dump materials from vehicles.

#### 1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

##### 1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

#### 1.7 TIME LIMITATIONS

##### 1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

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## PART 2 PRODUCTS

### 2.1 SODS

#### 2.1.1 Classification

Nursery grown, certified as classified in the TPI GSS. Machine cut sod at a uniform thickness of 3/4 inch within a tolerance of 1/4 inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected. Wood pegs and wire staples for anchorage shall be as recommended by sod supplier.

#### 2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

#### 2.1.3 Planting Dates

Lay sod from April 1 to July 15 for warm season spring planting and from October 1 to November 30 for cool season fall planting.

#### 2.1.4 Composition

##### 2.1.4.1 Proportion

Proportion grass species as follows.

| Botanical Name        | Common Name      | Percent: |
|-----------------------|------------------|----------|
| Cynopon Dactylon "03" | 03 Bermuda Grass | 100%     |

### 2.2 TOPSOIL

#### 2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

### 2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

#### 2.3.1 Lime

Commercial grade hydrate limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 10 percent.

#### 2.3.2 Aluminum Sulfate

Commercial grade.

#### 2.3.3 Sulfur

100 percent elemental

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#### 2.3.4 Iron

100 percent elemental

#### 2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

#### 2.3.6 Sand

Clean and free of materials harmful to plants.

#### 2.3.7 Perlite

Horticultural grade.

#### 2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

##### 2.3.8.1 Particle Size

Minimum percent by weight passing:

|                   |    |
|-------------------|----|
| No. 4 mesh screen | 95 |
| No. 8 mesh screen | 80 |

##### 2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

|                  |     |
|------------------|-----|
| Fir Sawdust      | 0.7 |
| Fir or Pine Bark | 1.0 |

#### 2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

#### 2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

#### 2.4 FERTILIZER

##### 2.4.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following

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minimum percentages, by weight, of plant food nutrients:

21 percent available nitrogen  
7 percent available phosphorus  
14 percent available potassium

## 2.5 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

## PART 3 EXECUTION

### 3.1 PREPARATION

#### 3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

#### 3.1.2 Soil Preparation

Disk subgrade soil to a depth of 6 inches to break up hard pan. Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters and soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer as determined by the soils test. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

##### 3.1.2.1 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime 35 pounds per 1000 square feet.

##### 3.1.2.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Synthetic Granular Fertilizer pounds per 1000 square feet.

## 3.2 SODDING

### 3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK.



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The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

#### 3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

#### 3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

#### 3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

#### 3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

#### 3.2.6 Watering

Start watering areas sodded as required by daily temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to minimum depth of 6 inches. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.

#### 3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

-- End of Section --

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SECTION 32 93 00

EXTERIOR PLANTS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |   |
|-------------|---|
| ANSI A300   | (1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance   |
| ANSI Z133.1 | (2006) Arboricultural Operations - Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush |
| ANSI Z60.1  | (1996) Nursery Stock  |

ASTM INTERNATIONAL (ASTM)

- |                   |  |
|-------------------|--|
| ASTM A 580/A 580M | (2006) Stainless Steel Wire  |
| ASTM D 1972       | (1997; R 2005) Standard Practice for Generic Marking of Plastic Products |
| ASTM D 4972       | (2001) pH of Soils   |
| ASTM D 5268       | (2002) Topsoil Used for Landscaping Purposes                             |

FOREST STEWARDSHIP COUNCIL (FSC)

- |                |   |
|----------------|---|
| FSC STD 01 001 | (2000) Principles and Criteria for Forest Stewardship |
|----------------|---|

L.H. BAILEY HORTORIUM (LHBH)

- |      |                     |
|------|---------------------|
| LHBH | (1976) Hortus Third |
|------|---------------------|

U.S. DEPARTMENT OF AGRICULTURE (USDA)

- |             |  |
|-------------|--|
| DOA SSIR 42 | (1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0 |
|-------------|--|

U.S. GREEN BUILDING COUNCIL (USGBC)

- |      |  |
|------|--|
| LEED | (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC) |
|------|--|

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## 1.2 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 92 19 SEEDING, Section 32 92 23 SODDING, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

State Landscape Contractor's License

Time Restrictions and Planting Conditions

Indicate anticipated dates and locations for each type of planting.

### SD-03 Product Data

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Peat  
Composted Derivatives  
Rotted Manure  
Mulch Materials  
Weed Control Fabric

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

Mulch; G  
Ground Stakes  
Hose; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Fertilizer

Staking Material  
Ground Stakes

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Submit documentation certifying products are from salvaged/recovered lumber sources and indicating percentage of salvaged/recovered content per unit of product.

Metal anchors

Antidesiccants

Photographs; G

#### SD-04 Samples

Mulch; G

Submit one pint of mulch.

Weed Control Fabric

Submit a 6" x 6" square Sample

#### SD-06 Test Reports

Topsoil composition tests; Soil Test of imported topsoil; Soil Test of proposed area; Soil Test location map

Percolation Test; Percolation Test of proposed area

#### SD-07 Certificates

Forest Stewardship Council (FSC) Certification; (LEED)

Nursery certifications

Indicate names of plants in accordance with the LHBH, including type, quality, and size.

#### SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D 4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test shall include a maximum depth of 18 inches of approximately 1 quart volume for each test. Areas sampled should not be larger than 1 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent

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non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

#### 1.4.2 Nursery Certifications

- a. Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.
- b. Inspection certificate.
- c. Mycorrhizal fungi inoculum for plant material treated.

#### 1.4.3 State Landscape Contractor's License

Construction company shall hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

#### 1.4.4 Plant Material Photographs

Contractor shall submit nursery photographs, for government approval prior to ordering, for each tree larger than 2-inch caliper size.

#### 1.4.5 Percolation Test

Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, shall be measured by the project Landscape Architect and verified by the Contracting Officer. Within six hours of the time the water has drained from the pit, the Contractor, with the Contracting Officer and project Landscape Architect present, shall again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination shall be made whether a drainage system or a soil penetrant will be required for each tree and or shrub being transplanted.

#### 1.4.6 Pre-Installation Meeting

Convene a pre-installation meeting a minimum of one week prior to commencing work of this section. Require attendance of parties directly affecting work of this section. Review conditions of operations, procedures and coordination with related work. Agenda shall include the following:

- a. Tour, inspect, and discuss conditions of planting materials.
- b. Review planting schedule and maintenance.
- c. Review required inspections.
- d. Review environmental procedures.

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## 1.5 DELIVERY, STORAGE, AND HANDLING

### 1.5.1 Delivery

#### 1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

#### 1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulfur, iron, and lime may be furnished in bulk with a certificate indicating the above information. Store in dry locations away from contaminates.

#### 1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 60 days after delivery to the planting site.

### 1.5.2 Storage

#### 1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

- a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.
- b. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.
- c. Keep plants in a moist condition until planted by watering with a fine mist spray.
- d. Do not store plant material directly on concrete or bituminous surfaces.

#### 1.5.2.2 Fertilizer, Gypsum, pH Adjusters, and Mulch Storage

Store in dry locations away from contaminants.

#### 1.5.2.3 Topsoil

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

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#### 1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle boxed, balled and burlapped, bare root, balled and potted, processed balled, in-ground fabric bag grown, container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Puddle bare-root plants after removal from the heeling-in bed to protect roots from drying out. Remove damaged plants from the site.

#### 1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum of 24 hours.

#### 1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

Coordinate installation of planting materials during optimal planting seasons for each type of plant material required.

##### 1.6.1 Planting Dates

Plant all plants from April 15 to July 15 or October 1 to October 30.

##### 1.6.1.1 Deciduous Trees

Deciduous material from April 1 to July 15 for spring/summer planting and from October 1 to October 30 for fall/winter planting.

##### 1.6.1.2 Evergreen Material

Evergreen material from April 1 to July 15 for spring/summer planting and from October 1 to October 30 for fall/winter planting.

##### 1.6.2 Restrictions

Do not plant when ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

#### 1.7 GUARANTEE

All plants shall be guaranteed for one year beginning on the date of inspection by the Contracting Officer to commence the plant establishment period, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Government or by weather conditions unusual for the warranty period. Transplanted plants require no guarantee.

Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season. At end of warranty period, replace planting materials that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period.

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## 1.8 SUSTAINABLE DESIGN REQUIREMENTS

### 1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Landscaping materials may be locally available.

### 1.8.2 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in Operation and Maintenance Manual.

Type 1: Polyethylene Terephthalate (PET, PETE).

Type 2: High Density Polyethylene (HDPE).

Type 3: Vinyl (Polyvinyl Chloride or PVC).

Type 4: Low Density Polyethylene (LDPE).

Type 5: Polypropylene (PP).

Type 6: Polystyrene (PS).

Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

### 1.8.3 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

## PART 2 PRODUCTS

### 2.1 PLANTS

#### 2.1.1 Regulations and Varieties

Existing trees and shrubs to remain shall be protected and a planting plan be arranged around them. Furnish nursery stock in accordance with ANSI Z60.1, except as otherwise specified or indicated. Each plant or group of planting shall have a "key" number indicated on the nursery certifications of the plant schedule. Furnish plants, including turf grass, grown under climatic conditions similar to those in the locality of the project. Plants specified shall be low maintenance varieties, tolerant of site's existing soils and climate without supplemental irrigation or fertilization once established. Spray plants budding into leaf or having soft growth with an antidesiccant before digging. Plants of the same specified size shall be of uniform size and character of growth. Plants shall be chosen with their mature size and growth habit in mind to avoid over-planting and conflict with other plants, structures or underground utility lines. All plants shall comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

#### 2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free



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from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

#### 2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

#### 2.1.2.2 Evergreen Trees and Shrubs

Well developed symmetrical tops with typical spread of branches for each particular species or variety.

#### 2.1.2.3 Ground Covers and Vines

Number and length of runners and clump sizes indicated, and of the proper age for the grade of plants indicated, furnished in removable containers, integral containers, or formed homogeneous soil section.

#### 2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, shall conform to measurements indicated, based on the average width or height of the plant for the species as specified in ANSI Z60.1. Plants larger in size than specified may be provided with approval of the Contracting Officer. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

#### 2.1.4 Root Ball Size

All box-grown, field potted, field boxed, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls shall conform to ANSI Z60.1. All wrappings and ties shall be biodegradable. Root growth in container grown plants shall be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

#### 2.1.4.1 Mycorrhizal fungi inoculum

Before shipment, root systems shall contain mycorrhizal fungi inoculum.

#### 2.1.5 Growth of Trunk and Crown

##### 2.1.5.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANSI Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.

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#### 2.1.5.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANSI Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

#### 2.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANSI Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

#### 2.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANSI Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

#### 2.1.5.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANSI Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

### 2.2 TOPSOIL

#### 2.2.1 Existing Soil

Modify to conform to requirements specified in paragraph entitled "Composition."

#### 2.2.2 On-Site Topsoil

Surface soil stripped and stockpiled on site and shall not be used as shrub bed material or as tree backfill.

#### 2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

#### 2.2.4 Composition

Evaluate soil for use as topsoil in accordance with ASTM D 5268. From 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, plants, and other debris and objectionable materials. Other components shall conform to the following limits by volume:

|                  |                      |
|------------------|----------------------|
| Organic Material | Minimum of 2 percent |
| Silt             | 15 percent minimum   |

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|                  |                      |
|------------------|----------------------|
| Clay             | 15-30 percent        |
| Sand             | 15-35 percent        |
| pH               | 6.6 to 7.0           |
| Soluble Salts    | 600 ppm maximum      |
| Foreign Material | Maximum of 1 percent |

## 2.3 SOIL CONDITIONERS

### 2.3.1 Rotted Manure

Well rotted horse or cattle manure containing maximum 25 percent by volume of straw, sawdust, or other bedding materials; free of seeds, stones, sticks, soil, and other invasive species.

## 2.4 PLANTING SOIL MIXTURES

100 percent topsoil as specified herein.

## 2.5 FERTILIZER

Fertilizer for groundcover, wildflowers and grasses is not permitted. Fertilizer for trees, plants, and shrubs shall be as recommended by plant supplier, except synthetic chemical fertilizers are not permitted. Fertilizers containing petrochemical additives or that have been treated with pesticides or herbicides are not permitted.

### 2.5.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

- 24 percent available nitrogen
- 8 percent available phosphorus
- 16 percent available potassium

### 2.5.2 Fertilizer Tablets

Organic, plant tablets composed of tightly compressed fertilizer chips forming a tablet that is insoluble in water, is designed to provide a continuous release of nutrients for at least 24 months and contains the following minimum percentages, by weight, of plant food nutrients:

- 20 percent available nitrogen
- 10 percent available phosphorus
- 5 percent available potassium

## 2.6 WEED CONTROL FABRIC

### 2.6.1 Roll Type Polypropylene or Polyester Mats

Fabric shall be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric shall be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring, yet allowing air, water and nutrients to pass thru to the roots. Minimum weight shall be 0.11 kg per square meter 5 ounces per square yard with a minimum thickness of 0.50 mm 20 mils with a 20 year (minimum) guarantee.

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## 2.7 MULCH

Free from noxious weeds, mold, pesticides, or other deleterious materials.

### 2.7.1 Inert Mulch Materials

River bank stone or granite chips ranging in size from 1/8" to 1/4", locally supplied in the area or state of Oklahoma.

## 2.8 STAKING AND GUYING MATERIAL

### 2.8.1 Staking Material

#### 2.8.1.1 Tree Support Stakes

Rough sawn FSC-certified hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 2 1/2 inch diameter by 8 feet long, pointed at one end. Stain wood stakes dark brown.

#### 2.8.1.2 Ground Stakes

FSC-certified, pointed at one end.

### 2.8.2 Guying Material

#### 2.8.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A 580/A 580M.

#### 2.8.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable plastic coated.

### 2.8.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

### 2.8.4 Flags

White 1/2 inch diameter PVC pipe, 12 inches long, fastened to guying wires or cables.

### 2.8.5 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts shall be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1 1/2 inches, minimum.

### 2.8.6 Metal Anchors

#### 2.8.6.1 Screw Anchors

Steel, screw type with welded-on 3 inch round helical steel plate, minimum 3/8 inch diameter, 15 inches long.

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## 2.9 EDGING MATERIAL

### 2.9.1 Concrete Edging

Cast-in-place 8 by 8 inch concrete mowstrip. Provide tooled or saw cut contraction joints to a depth of 3/4 inch after the surface has been finished. Provide joints every 5 lineal feet. Provide 1/2 inch thick expansion joints at change of direction, where mowstrip abuts rigid pavement, and at 50 foot on center. Provide #4 reinforcement bar and other devices necessary to install and secure reinforcement. Provide a floated finish, then finish with a flexible bristle broom. 3,000 psi compressive concrete strength at 28 days as specified under Section 03 30 00.00 20 CAST-IN-PLACE CONCRETE.

### 2.10 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film shall form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

### 2.11 WATER

Source of water to be approved by Contracting Officer and suitable quality for irrigation and shall not contain elements toxic to plant life, including acids, alkalis, salts, chemical pollutants, and organic matter. Use collected storm water or graywater when available.

#### 2.11.1 Hose

Hoses used for watering shall be a minimum of 60 to 70 percent post-consumer rubber or plastic.

### 2.12 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

### 2.13 SOURCE QUALITY CONTROL

The Contracting Officer will inspect plant materials at the project site and approve them. Tag plant materials for size and quality.

## PART 3 EXECUTION

### 3.1 EXTENT OF WORK

Provide soil preparation, fertilizing, tree, shrub, groundcover, planting, edging, staking and guying, and a mulch topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

### 3.2 ALTERNATIVE HERBICIDE TREATMENT (SOLARIZING SOIL)

Within 48 hours of subsoil preparation, saturate soil with water to a depth of 3 feet. Immediately stake polyethylene sheeting over area to be planted. Stake tightly to surface of soil. Maintain sheeting in place for

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a minimum of 6 weeks. Immediately after removing sheeting, cover area to be planted with topsoil. Do not till soil prior to applying topsoil.

### 3.3 PREPARATION

#### 3.3.1 Protection

Protect existing and proposed landscape features, elements, and sites from damage or contamination. Protect trees, vegetation, and other designated features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than the drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on Drawings.

#### 3.3.2 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet field conditions. Do not shrub closer than 12 inches to a building wall, fence or wall edge and other similar structures. Provide on-site locations for excavated rock, soil, and vegetation.

#### 3.3.3 Soil Preparation

##### 3.3.3.1 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic granular fertilizer 3 pounds per 1000 square feet.

#### Fertilizer Tablets for Trees and Shrubs

|        | <u>Container/Caliper Size</u> | <u>Tablet Size</u> | <u>No. of Tablets</u> |
|--------|-------------------------------|--------------------|-----------------------|
| Shrub: | 1 gal                         | 21 g               | 1                     |
| Tree:  | 3 gal                         | 21 g               | 2                     |
|        | 5 gal                         | 21 g               | 3                     |
|        | 1" to 3" cal                  | 21 g               | 5                     |

### 3.4 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Do not disturb topsoil and vegetation in areas outside those indicated on Drawings. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation shall be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph entitled "Plant Installation." Do not install trees within 10 feet of any utility lines or building walls.

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### 3.5 PLANT INSTALLATION

#### 3.5.1 Individual Plant Pit Excavation

Excavate pits at least twice as large in diameter as the size of ball or container to depth shown.

#### 3.5.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

#### 3.5.3 Handling and Setting

Move plant materials only by supporting the root ball container. Set plants on hand compacted layer of prepared backfill soil mixture 8 inches thick and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, 1 inch above depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas.

##### 3.5.3.1 Balled and Burlapped Stock

Backfill with prepared soil mixture topsoil to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

##### 3.5.3.2 Container Grown Stock

Remove from container and prevent damage to plant or root system.

##### 3.5.3.3 Ground Covers

Plant after placing mulch topdressing. Do not remove plant materials from flats or containers until immediately before planting. Space at intervals indicated. Plant at a depth to sufficiently cover all roots. Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 6 inches without run off or puddling. Smooth planting areas after planting to provide even, smooth finish. Mulch as indicated.

##### 3.5.3.4 Weed Control Fabric Installation

Remove grass and weed vegetation, including roots, from within the area enclosed by edging. Completely cover areas enclosed by edging with specified weed control fabric prior to placing mulch layer. Overlap cut edges 6 inches.

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#### 3.5.3.5 Placement of Mulch Topdressing

Place specified mulch topdressing on top of weed control fabric covering total area enclosed by edging. Place mulch topdressing to a depth of 2 inches.

#### 3.5.4 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 3 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2 to 3 inches away from trunk of shrub or tree.

#### 3.5.5 Installation of Edging

Uniformly edge beds of plants to provide a clear cut division line between planted area and adjacent lawn. Construct bed shapes as indicated. Install concrete edging material as indicated.

#### 3.5.6 Fertilization

##### 3.5.6.1 Fertilizer Tablets

Place fertilizer planting tablets evenly spaced around the plant pits to the manufacturer's recommended depth.

##### 3.5.6.2 Granular Fertilizer

Apply granular fertilizer as a top coat prior to placing mulch layer and water thoroughly.

#### 3.5.7 Watering

Start watering areas planted as required by temperature and wind conditions. Slow deep watering shall be used. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 12 inches without run off or puddling. Watering of other plant material or adjacent areas shall be prevented.

#### 3.5.8 Staking and Guying

##### 3.5.8.1 Staking

Stake plants with the number of stakes indicated complete with double strand of 12 gage guy wire as detailed. Attach guy wire half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 1/2 to 3 feet into the ground outside the plant pit. Do not injure the root ball. Use hose chaffer guards where guy wire comes in contact with tree trunk.

#### 3.5.9 Pruning

Prune in accordance with safety requirement of ANSI Z133.1.

##### 3.5.9.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and



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spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars shall remain in place. Pruning shall be accomplished by trained and experienced personnel and shall be accordance with ANSI A300.

#### 3.5.9.2 Wound Dressing

Do not apply tree wound dressing to cuts.

### 3.6 RESTORATION AND CLEAN UP

#### 3.6.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

#### 3.6.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite at an approved landfill, recycling center, or composting center. Separate and recycle or reuse the following landscape waste materials: nylon straps, wire, ball wrap, burlap, and wood stakes. Adjacent paved areas shall be cleared.

-- End of Section --

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SECTION 32 96 00

TRANSPLANTING EXTERIOR PLANTS  
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

ANSI Z133.1 (2001) Arboricultural Operations -- Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush

ANSI Z60.1 (1996) Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM A 580/A 580M (1998; R 2004) Stainless Steel Wire

ASTM C 602 (1995a; R 2001) Agricultural Liming Materials

ASTM D 4427 (1992; R 2002e1) Peat Samples by Laboratory Testing

ASTM D 4972 (2001) pH of Soils

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2000) Principles and Criteria for Forest Stewardship

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42 (1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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## 1.2 RELATED REQUIREMENTS

Section 02 41 00 DEMOLITION, Section 31 00 00 EARTHWORK Section 32 92 19 SEEDING, Section 32 92 23 SODDING, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for requirements, with additions and modifications herein.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

State Landscape Contractor's License & Tree Relocation References

Permits

Photographs

### SD-02 Shop Drawings

Transplanting Plan; G

### SD-03 Product Data

Equipment

A listing of equipment to be used for the transplanting operation, including size model, year and type of mechanical tree transplanting equipment.

Gypsum; (LEED)

Mulches Topdressing; (LEED)

Ground Stakes

Hose; (LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Peat

Composted Derivatives

Rotted Manure

Organic Mulch Materials

Documentation indicating type of biobased material in product

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and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

Staking Material; G  
Ground Stakes

Documentation certifying products are from salvaged/recovered lumber sources and indicating percentage of salvaged/recovered content per unit of product.

#### SD-06 Test Reports

Soil Test; G

Percolation Test

#### SD-07 Certificates

Forest Stewardship Council (FSC) Certification; G

### 1.4 QUALITY ASSURANCE

#### 1.4.1 State Landscape Contractor's License & Tree Relocation References

Contractor shall be a professional tree moving company holding a landscape contractor's license in the state where the work is to be performed and have a minimum of 10 years tree relocation experience. Submit a copy of license and 3 references of tree relocation work in the past 5 years.

#### 1.4.2 Permits

The Contractor shall obtain and pay for permits and fees for the alteration of overhead lines or any other related moving permit or fee that requires compliance with Federal, State and local regulatory requirements.

#### 1.4.3 Photographs

The contractor shall provide a clear 4 inch by 6 inch minimum size color photograph of the plant material to be relocated. Trees shall be documented by an individual photograph of each. Photographs shall indicate the date and species of each plant on the back or front of each photo.

#### 1.4.4 Transplanting Plan

A transplanting plan shall be submitted showing existing and proposed locations of transplanted material. The plan shall also delineate methods, dates, and times for root pruning, digging, balling, removing, storing, transporting, planting, watering, and maintenance to ensure survivability. The plan shall also include equipment and anti-desiccant to be used. A listing of the plant material to be transplanted shall be provided by common name and botanical name as listed under "Nomenclature" in ANSI Z60.1; classification; caliper; and height.

#### 1.4.5 Pre-Installation Meeting

Convene a pre-installation meeting a minimum of one week prior to commencing work of this section. Require attendance of parties directly affecting work of this section. Review conditions of operations,

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procedures and coordination with related work. Agenda shall include the following:

- a. Tour, inspect, and discuss conditions of planting materials.
- b. Review planting schedule and maintenance.
- c. Review required inspections.
- d. Review environmental procedures.

#### 1.4.6 Soil Test

Commercial test from an independent testing laboratory according to the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42 including basic soil groups (sand, silt, clay, pH (ASTM D 4972), soluble salts), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper). Soil required for each test shall include a maximum depth of 18 inches of approximately 1 quart volume for each test. Areas sampled should not be larger than 1 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

#### 1.4.7 Percolation Test

Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, shall be measured by the project Landscape Architect and verified by the Contracting Officer. Within six hours of the time the water has drained from the pit, the Contractor, with the Contracting Officer and project Landscape Architect present, shall again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination shall be made and submitted by the Contractor and verified and approved by the Contracting Officer, whether a drainage system or a soil penetrant will be required for each tree and or shrub being transplanted.

### 1.5 DELIVERY OF MATERIALS

#### 1.5.1 Soil Conditioners Delivery and Storage

Soil conditioners shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil conditioners may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries. Store in dry locations and away from contaminants.

### 1.6 PLANT MATERIAL IDENTIFICATION

Plant material to be transplanted shall be tagged and/or shown on drawings. Transplanted plant material shall be delivered with attached, durable, waterproof labels and weather-resistant ink or imprinted tags, stating the correct botanical and common plant name and size.

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#### 1.7 INSPECTION OF MATERIALS

Materials shall be inspected for compliance with paragraph PRODUCTS and paragraph PLANT MATERIAL IDENTIFICATION. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 1-1/2 inch diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material shall be removed from the job site. The Contracting Officer reserves the right to refuse any unacceptable plant material. All rejected plant material shall be removed from the job site on the day of rejection.

#### 1.8 HANDLING OF PLANT MATERIALS

Materials shall not be dropped from vehicles. Plant material shall be transported without scarring trunks or deforming crown branching. Materials found to be in unacceptable condition shall be replaced at no additional cost to the Government.

#### 1.9 TIME LIMITATION

The time limitation from digging, removing, transporting, to installing transplanted plant material shall be the same day. The time limitation between installing the plant material and placing the mulch shall be a maximum 48 hours. If project conditions prevent the Contractor from transplanting and installing plant material on the same day, plant materials shall be boxed or heeled in as required. Plant material shall be maintained and protected by the Contractor.

#### 1.10 GUARANTEE

Transplanted plant material shall have a guarantee period of 365 days. All plants that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period, shall be replaced in kind in relation to size and species during the planting season from April 1 to June 30. Trees that are approved for use as replacements are Southern Red Oaks, Lacebark Elm, Shumard Oak, Cedar Elm, Live Oak and Chinese Pistache. Written approval must be obtained from Contracting Officer.

#### 1.11 TRANSPLANTED PLANT MATERIAL TIME AND CONDITIONS

Coordinate installation of planting materials during optimal planting seasons for each type of plant material required.

##### 1.11.1 Deciduous Plant Material Time

Deciduous plant material shall be transplanted from Nov 1 to Feb 28.

##### 1.11.2 Evergreen Plant Material Time

Evergreen plant material shall be transplanted from Nov 1 to March 15.

##### 1.11.3 Transplanting Conditions

All transplanting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to all

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transplanting operations, proposed transplanting times shall be submitted for approval. The installing site for the plant material shall be prepared and excavated in accordance with paragraph SITE EXCAVATION, prior to removing the plant material. If project conditions prevent the Contractor from transplanting and installing plant material on the same day, plant material shall be boxed or heeled in as required. Plant material shall be maintained by the Contractor until a suitable planting time.

#### 1.11.4 Underground Utilities

The location of underground utilities and facilities at both the removal and installing sites shall be verified and marked. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

#### 1.11.5 Protecting Existing Vegetation

When there are established lawns at the installing sites, the turf shall be protected during the operation. Existing trees, shrubs, and plant beds at the installing sites that are to be preserved shall be barricaded and protected from damage by a tree barricade or other measure. Damage to existing plant material shall be mitigated by the Contractor at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

#### 1.11.6 Protection of Plant Material to be Transplanted

Contractor shall protect plant material slated for transplanting that is not transplanted at the beginning of construction operations. Prior to construction operations, Contractor shall tag plants to be transplanted with plastic or vinyl tape tied to the plant caliper. Plants to be transplanted shall be protected from root compaction and any other damage (with barrier of metal poles a maximum of 8 feet on center with plastic fluorescent netting) at a minimum of 20 foot diameter from outside of the plant's trunk prior to the start of any construction operations. Where tree drip lines are greater than 10 feet from the tree's trunk, locate barrier fencing at the drip line of the tree. Plastic tape and barrier fencing shall not be removed until transplanting operations are ready to begin and or instructed by the Contracting Officer. Contractor shall water and prune plant material as necessary to keep healthy and vigorous, particularly when water is shut off. Contractor shall be responsible for watering existing plant material to be transplanted from the start of construction operations until the maintenance period is over. Outside storage locations shall be continually shaded and protected from the wind. Bare root plants shall be heeled in. Plants stored on the project shall be protected from any drying at all times covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.

#### 1.11.7 Protection of Plant Material During Transplanting

Plant material shall be protected during transplanting to prevent desiccation and damage to the branches, trunk, and root system. Branches of shrubs, palms, vines shall be protected by tying-in. Exposed branches shall be covered during transport. Plant material shall be undamaged, vigorous and healthy with a well-branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion after transplanting. Plant material showing desiccation, abrasion, sun scald injury or structural branching damage shall be replaced

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at no cost to the government.

#### 1.12 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.12.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

##### 1.12.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

### PART 2 PRODUCTS

#### 2.1 TOPSOIL

Topsoil to be placed around root balls of transplanted material at new planting site shall match topsoil of existing site where material is transplanted from, based on soil tests taken at both the current growing area and the proposed growing site. Minimum matching characteristics shall include: ph, organic matter, soluble salts, percentages of silt, clay and sand. Existing soil shall be used as topsoil. Stockpiled on-site surface soil shall be used as topsoil. Additional topsoil shall be furnished by the Contractor. Soil conditioners may be added to topsoil to bring into compliance.

#### 2.2 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

##### 2.2.1 Lime

Commercial grade hydrated limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 110 percent.

##### 2.2.2 Aluminum Sulfate

Commercial grade.

##### 2.2.3 Sulfur

100 percent elemental

##### 2.2.4 Iron

100 percent elemental

##### 2.2.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after



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excavation. Biobased content shall be a minimum of 100 percent. Peat shall not contain invasive species, including seeds.

#### 2.2.6 Sand

Clean and free of materials harmful to plants.

#### 2.2.7 Perlite

Horticultural grade.

#### 2.2.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, invasive species, including seeds, and soil stabilized with nitrogen and having the following properties:

##### 2.2.8.1 Particle Size

Minimum percent by weight passing:

|                   |    |
|-------------------|----|
| No. 4 mesh screen | 95 |
| No. 8 mesh screen | 80 |

##### 2.2.8.2 Nitrogen Content

Minimum percent based on dry weight:

|                  |     |
|------------------|-----|
| Fir Sawdust      | 0.7 |
| Fir or Pine Bark | 1.0 |

##### 2.2.8.3 Biobased Content

Minimum 100 percent.

#### 2.2.9 Gypsum

Coarsely ground gypsum from recycled scrap gypsum board comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

#### 2.2.10 Vermiculite

Horticultural grade for planters.

#### 2.2.11 Rotted Manure

Well rotted horse or cattle manure containing maximum 25 percent by volume of straw, sawdust, or other bedding materials; free of seeds, stones, sticks, soil, and other invasive species.

### 2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, pesticides, or other deleterious materials.

#### 2.3.1 Inert Mulch Materials

Riverbank stone or volcanic rock ranging in size from 1 to 3 inches.

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Provide materials from site and construction waste to the greatest extent possible. Mulch shall contain a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent post-industrial recycled content.

#### 2.3.2 Organic Mulch Materials

Wood cellulose fiber, wood chips, ground or shredded bark, shredded hardwood, pine straw mulch, pine needles from site when available. Biobased content shall be a minimum of 100 percent. Wood cellulose fiber shall be processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application. Paper-based hydraulic mulch shall contain a minimum of 100 percent post-consumer recycled content. Wood-based hydraulic mulch shall contain a minimum of 100 percent recycled material.

#### 2.3.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 inch x 2-1/2 inch screen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inch length. The material shall be pretreated to retard the growth of mold and fungi.

### 2.4 STAKING AND GUYING MATERIAL

#### 2.4.1 Staking Material

##### 2.4.1.1 Tree Support Stakes

Rough sawn, FSC-certified or salvaged, hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 2 1/2 inch diameter by 8 feet long, pointed at one end.

##### 2.4.1.2 Ground Stakes

FSC-certified or salvaged wood or 100 percent post-consumer recycled content plastic, 3 feet long.

#### 2.4.2 Guying Material

##### 2.4.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A 580/A 580M.

##### 2.4.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable plastic coated.

##### 2.4.2.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

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#### 2.4.2.4 Flags

White surveyor's plastic tape, 6 inches long, fastened to guying wires or cables.

#### 2.4.2.5 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts shall be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1 1/2 inches, minimum.

#### 2.4.2.6 Deadmen

4 by 8 inch rectangular or 8 inch diameter by 36 inches long, pine or fir wood material.

#### 2.4.2.7 Metal Anchors

##### a. Driven Anchors

Malleable iron, arrow shaped, galvanized, sized as follows:

| <u>Tree Caliper</u> | <u>Anchor Size</u> |
|---------------------|--------------------|
| 2 inches and under  | 3 inches           |
| 3 to 6 inches       | 4 inches           |
| 6 to 8 inches       | 6 inches           |
| 8 to 10 inches      | 8 inches           |
| 10 to 12 inches     | 10 inches          |

##### b. Screw Anchors

Steel, screw type with welded-on 3 inch round helical steel plate, minimum 3/8 inch diameter, 15 inches long.

### 2.5 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall be potable or non-potable, and may be supplied by an existing irrigation system or by collected storm water or a graywater system.

#### 2.5.1 Hose

Hoses used for watering shall be a minimum of 70 percent post-consumer rubber or plastic.

## PART 3 EXECUTION

### 3.1 PLANT MATERIAL PREPARATION AND HANDLING

#### 3.1.1 Pruning

##### 3.1.1.1 Canopy Pruning

Canopy pruning shall conform to ANSI A300.

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### 3.1.2 Plant Material Preparation

Plant material designated for transplanting shall be watered thoroughly several days before digging or moving. Broken or interfering growth shall be pruned. Large canopy and specimen plant material shall be wire balled and burlapped or spaded. Mark north side of plants prior to excavation. Relocate in new location with north facing same direction.

## 3.2 SITE PREPARATION

### 3.2.1 Protection

Protect existing and proposed landscape features, elements, and sites from damage or contamination. Protect trees, vegetation, and other designated features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than the drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on Drawings.

### 3.2.2 Finish Grade and Topsoil

The Contractor shall verify that finish grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the transplanting operation.

### 3.2.3 Layout

Relocate plant material as shown on drawings. Plant material locations may be adjusted to meet field conditions, only with Contracting Officer approval. Provide on-site locations for excavated rock, soil, and vegetation.

### 3.2.4 Erosion Control

Provide erosion control in accordance with the contract drawings, and by seeding with native plant species to protect slopes.

## 3.3 SITE EXCAVATION

### 3.3.1 Obstructions Above or Below Ground

When obstructions above or below ground affect the work, shop drawings showing proposed adjustments to plant material location, and planting method shall be submitted for Government approval.

### 3.3.2 Turf Removal and Replacement

Do not disturb topsoil and vegetation in areas outside those indicated on Drawings. Where the installation operation occurs in an existing lawn area, the turf shall be removed from the excavation area to a depth that will ensure the removal of the entire root system.

### 3.3.3 Plant Pits

Plant pits shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits shall be dug a minimum of 2 times the diameter of the root system to

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allow for root expansion. The pit shall be constructed with sides sloping towards the base as a cone, to encourage well-aerated soil to be available to the root system for favorable root growth. Cylindrical pits with vertical sides shall not be used. Pits shall be dug immediately before plants are placed in the pit.

### 3.4 INSTALLATION

#### 3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient top soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown. The root system shall be spread out and arranged in its natural position. Damaged or girdled roots shall be removed with a clean cut. The beginning of the root flare shall be visible at soil level when the tree is planted, since it is critical not to plant the tree too deep. The following shall be performed:

- a. Plumb plant materials and backfill half of the hole with topsoil.
- b. Prior to backfilling, all metal, wood, and synthetic products shall be removed from the ball or root system avoiding damage to the root system. Biodegradable burlap and tying material shall be carefully opened and folded back from the top a minimum 1/3 depth from the top of the root ball.
- c. Water the hole to collapse air pockets.
- d. Backfill and gently firm topsoil.
- e. Clear soil mounded against trunk.
- f. An earth berm, consisting of backfill soil mixture, shall be formed with a minimum 4 inch height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

#### 3.4.2 Watering

A regular watering schedule shall be established. Slow deep watering shall be used. Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated. Run-off and puddling shall be prevented. Watering of other plant material or adjacent areas shall be prevented.

#### 3.4.3 Staking and Guying

Staking will be required when trees are unstable or will not remain set due to their size, shape, or exposure to high wind velocity. When required the following staking and guying procedures shall apply:

##### 3.4.3.1 One Bracing Stake

Trees 4 to 6 feet high shall be firmly anchored in place with one bracing stake. The bracing stake shall be placed on the side of the tree facing the prevailing wind. The bracing stake shall be driven vertically into firm ground and shall not injure the ball or root system. The tree shall be held firmly to the stake with a double strand of guying material. The

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guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. A chafing guard shall be used when metal is the guying material.

#### 3.4.3.2 Two Bracing Stakes

Trees from 6 to 8 feet height shall be firmly anchored in place with 2 bracing stakes placed on opposite sides. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or root system. The tree shall be held firmly between the stakes with a double strand of guying material. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. Chafing guards shall be used when metal is the guying material.

#### 3.4.3.3 Three Bracing or Ground Stakes

Trees over a minimum 8 feet height and less than a maximum 6 inch caliper shall be held firmly in place with 3 bracing or ground stakes spaced at equal intervals around the tree. Ground stakes shall be avoided in areas to be mowed. Stakes shall be driven into firm ground outside the earth berm. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. For trees over a minimum 3 inch diameter at breast height, turnbuckles shall be used on the guying material for tree straightening purposes. One turnbuckle shall be centered on each guy line. Chafing guards shall be used when metal is the guying material.

#### 3.4.4 Deadmen or Earth Anchors

Trees over a minimum 6 inch caliper shall be held firmly in place with wood deadmen buried a minimum 3 feet in the ground or metal earth anchors. Multi-strand cable guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. Turnbuckles shall be used on the guying material for tree straightening purposes. One turnbuckle shall be centered on each guy line. Chafing guards shall be used.

#### 3.4.5 Flags

A flag shall be securely fastened to each guy line between the tree, stake, deadmen, or earth anchor. The flag shall be visible to pedestrians.

### 3.5 FINISHING

All planting operations shall conform to ANSI Z133.1.

#### 3.5.1 Plant Material

Prior to placing mulch, the installed area shall be uniformly edged to provide a clear division line between the planted area and the adjacent turf area, shaped as indicated. The installed area shall be raked and smoothed while maintaining the earth berms.

#### 3.5.2 Placing Mulch

The placement of mulch shall occur a maximum of 48 hours after planting. Mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, shall be spread to cover the installed area with a minimum 3 inch uniform thickness. Mulch shall be kept out of the crowns of shrubs, ground cover, and vines and shall be kept off buildings, sidewalks and other facilities.

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### 3.5.3 Pruning

Pruning shall be accomplished by a certified arborist. The pruning of trees and palms shall be in accordance with ANSI A300. Only dead or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Broken branches shall be removed.

### 3.6 MAINTENANCE

Plant maintenance shall be in accordance with Section 32 05 33 LANDSCAPE ESTABLISHMENT.

### 3.7 RESTORATION AND CLEAN UP

#### 3.7.1 Restoration

Turf areas containing ruts or dead turf, as a result of work under this contract, shall be graded smooth and sodded with the same species. All pavements and facilities that have been damaged from the transplanting operation shall be restored to original condition at the Contractor's expense.

#### 3.7.2 Backfill Removal Site Plant Pits

The Contractor shall ensure that all remaining holes from the removal site have been backfilled with on-site soil, tamped to 90 percent compaction, leveled and finished to meet existing grade after settling. Adjacent trees, shrubs, vines and groundcover destroyed by transplanting or construction operations shall be replaced in kind in relation to size and species and shall be installed in accordance with this section. Turf shall be replaced with seed, and shall be installed in accordance with Section 32 92 19 SEEDING.

#### 3.7.3 Clean Up

Excess and waste material shall be removed from both removal site and the installed site and shall be disposed of in the Ft. Sill Sanitary Landfill. Adjacent paved areas shall be cleared.

### 3.8 PLANT ESTABLISHMENT PERIOD

The establishment period for transplanted materials shall be the same as for newly planted exterior plants and shall conform to the same requirements thereof as found in Section 32 05 33 LANDSCAPE ESTABLISHMENT, paragraph titled "Exterior Plant Establishment Period."

-- End of Section --

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SECTION 33 40 01

STORM DRAINAGE  
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

|              |   |
|--------------|---|
| AASHTO HB-17 | (2002; Errata 2003) Standard Specifications for Highway Bridges   |
| AASHTO M 198 | (2005) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| AASHTO M 294 | (2003) Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter   |
| AASHTO MP7   | (2001) Specification for Corrugated Polyethylene Pipe, 1350 and 1500 mm Diameter                            |

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION  
(AREMA)

|              |                                       |
|--------------|---------------------------------------|
| AREMA Manual | (2005) Manual for Railway Engineering |
|--------------|---------------------------------------|

ASTM INTERNATIONAL (ASTM)

|                   |  |
|-------------------|--|
| ASTM A 123/A 123M | (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products                   |
| ASTM A 48/A 48M   | (2003) Gray Iron Castings  |
| ASTM A 536        | (1984; R 2004) Ductile Iron Castings   |
| ASTM C 1103       | (2003) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines         |
| ASTM C 1433       | (2004) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers |
| ASTM C 231        | (2004) Air Content of Freshly Mixed Concrete by the Pressure Method                    |
| ASTM C 270        | (2005a) Mortar for Unit Masonry  |
| ASTM C 425        | (2004) Compression Joints for Vitrified  |



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#### Clay Pipe and Fittings

|             |   |
|-------------|---|
| ASTM C 443  | (2005) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets  |
| ASTM C 478  | (2003a) Precast Reinforced Concrete Manhole Sections  |
| ASTM C 76   | (2005a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe  |
| ASTM C 828  | (2003) Low-Pressure Air Test of Vitrified Clay Pipe Lines   |
| ASTM C 923  | (2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals  |
| ASTM C 924  | (2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method  |
| ASTM D 1557 | (2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))               |
| ASTM D 1751 | (2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| ASTM D 1752 | (2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction                      |
| ASTM D 1784 | (2003) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds                               |
| ASTM D 2167 | (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method  |
| ASTM D 2321 | (2005) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications                                  |
| ASTM D 2922 | (2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)   |
| ASTM D 3017 | (2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)   |
| ASTM D 3034 | (2004a) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings   |
| ASTM D 3212 | (1996a; R 2003) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals   |

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|             |   |
|-------------|---|
| ASTM D 3350 | (2002a) Polyethylene Plastics Pipe and Fittings Materials   |
| ASTM F 1417 | (1992; R 2005) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air                  |
| ASTM F 477  | (2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe   |
| ASTM F 679  | (2003) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings                      |
| ASTM F 714  | (2003) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter                                      |
| ASTM F 794  | (2003) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter |
| ASTM F 894  | (1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe                                    |
| ASTM F 949  | (2003) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings                   |

OKLAHOMA DEPARTMENT OF TRANSPORTATION STANDARD CONSTRUCTION  
SPECIFICATIONS

Section 701

Portland Cement Concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Culverts and Storm Drains

Samples of the materials, before work is started.

SD-07 Certificates

Resin Certification  
Pipeline Testing

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Hydrostatic Test on Watertight Joints  
Determination of Density  
Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.  
Certification on the ability of frame and cover or gratings to carry the imposed live load.

### 1.3 DELIVERY, STORAGE, AND HANDLING

#### 1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

#### 1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## PART 2 PRODUCTS

### 2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

#### 2.1.1 Concrete Pipe

ASTM C 76, Class III, IV or V as indicated on the drawings.

#### 2.1.2 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

##### 2.1.2.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

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#### 2.1.1.2.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

#### 2.1.1.2.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

#### 2.1.1.2.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

#### 2.1.1.3 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

##### 2.1.1.3.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

##### 2.1.1.3.2 Corrugated PE Pipe

AASHTO M 294, Type S or D, for pipes 12 to 48 inches and AASHTO MP7, Type S or D, for pipes 54 to 60 inches produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class in accordance with AASHTO M 294. Pipe walls shall have the following properties:

| Nominal<br>Size<br>(in.) | Minimum<br>Wall Area<br>(square in/ft) | Minimum Moment<br>of Inertia of<br>Wall Section<br>(in to the 4th/in) |
|--------------------------|--|---|
| 12                       | 1.50                                   | 0.024   |
| 15                       | 1.91                                   | 0.053   |
| 18                       | 2.34                                   | 0.062   |
| 24                       | 3.14                                   | 0.116   |
| 30                       | 3.92                                   | 0.163   |
| 36                       | 4.50                                   | 0.222   |
| 42                       | 4.69                                   | 0.543   |
| 48                       | 5.15                                   | 0.543   |

## 2.2 DRAINAGE STRUCTURES

### 2.2.1 Precast Reinforced Concrete Box

Boxes subjected to highway loadings shall conform to ASTM C 1433.

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## 2.3 MISCELLANEOUS MATERIALS

### 2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 psi concrete in accordance with ODOT Standard Specification Section 701, Class AA. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

### 2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 6 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

### 2.3.3 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

### 2.3.4 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

### 2.3.5 Joints

#### 2.3.5.1 Flexible Watertight Joints

- a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

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- b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

#### 2.3.5.2 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

#### 2.3.5.3 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

#### 2.3.5.4 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-17, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

#### 2.3.5.5 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

#### 2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

#### 2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48/A 48M, Class 30B or 35B. Shape and size shall be as indicated.

#### 2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

#### 2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

##### 2.7.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an

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additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

### PART 3 EXECUTION

#### 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

##### 3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

##### 3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheet piling, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

#### 3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

##### 3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

##### 3.2.2 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II

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material.

### 3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

| TYPE OF PIPE | MAXIMUM ALLOWABLE<br>DEFLECTION (%) |
|--------------|-------------------------------------|
| Plastic      | 7.5                                 |

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced.

#### 3.3.1 Concrete and PVC Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

#### 3.3.2 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

#### 3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

#### 3.3.4 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

### 3.4 JOINTING

#### 3.4.1 Concrete Pipe

##### 3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly



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cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

#### 3.4.1.2 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

#### 3.4.1.3 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

### 3.5 DRAINAGE STRUCTURES

#### 3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

#### 3.5.2 Walls and Headwalls

Construction shall be as indicated.

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### 3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

### 3.7 BACKFILLING

#### 3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 8 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

#### 3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

#### 3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

#### 3.7.4 Compaction

##### 3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will

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show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

#### 3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

#### 3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

#### 3.8 PIPELINE TESTING

##### 3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the

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pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 250 gallons per inch in diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

### 3.8.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

- a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:

- (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

- (2) A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

- (3) Center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

- (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

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- b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved by the Contracting Officer prior to use.
- c. Pull-through device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.
- d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.
- e. Warranty period test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

### 3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, to a minimum dry film thickness of 3 mil; and apply a top coat, to a minimum dry film thickness of 3 mils, color optional. Do not paint surfaces subject to abrasion.

-- End of Section --

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SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND  
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1 (2008) Specifications and Dimensions (for  
Wood Poles)

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8 (2000) Extruded Dielectric Shielded Power  
Cables Rated 5 Through 46 kV

AEIC CS8 (2000) Extruded Dielectric Shielded Power  
Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2008) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

ASTM A 153/A 153M (2005) Standard Specification for Zinc  
Coating (Hot-Dip) on Iron and Steel  
Hardware

ASTM A 48/A 48M (2003; R 2008) Standard Specification for  
Gray Iron Castings

ASTM B 117 (2007a) Standard Practice for Operating  
Salt Spray (Fog) Apparatus

ASTM B 3 (2001; R 2007) Standard Specification for  
Soft or Annealed Copper Wire

ASTM B 496 (2004) Standard Specification for Compact  
Round Concentric-Lay-Stranded Copper  
Conductors

ASTM B 8 (2004) Standard Specification for  
Concentric-Lay-Stranded Copper Conductors,  
Hard, Medium-Hard, or Soft

ASTM C 478 (2008) Standard Specification for Precast  
Reinforced Concrete Manhole Sections

ASTM C 478M (2008e1) Standard Specification for

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Precast Reinforced Concrete Manhole  
Sections (Metric)

|  |   |
|--|---|
| ASTM D 1654  | (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments  |
| ASTM F 883   | (2004) Padlocks   |
| FM GLOBAL (FM)   |   |
| FM P7825a  | (2005) Approval Guide Fire Protection   |
| INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) |   |
| IEEE C2  | (2007; Errata 2007; INT 2008) National Electrical Safety Code   |
| IEEE C37.20.1  | (2002; Addenda A 2005; Addenda B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear                     |
| IEEE C37.20.2  | (1999) Metal-Clad Switchgear  |
| IEEE C37.20.3  | (2001; R 2006) Metal-Enclosed Interrupter Switchgear  |
| IEEE C37.34  | (1994) Test Code for High-Voltage Air Switches  |
| IEEE C37.41  | (2000) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories    |
| IEEE C57.12.28   | (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity   |
| IEEE C62.11  | (2005; Amendment A 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)                             |
| IEEE Std 386   | (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V   |
| IEEE Std 404   | (2006) Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V Through 500 000 V   |
| IEEE Std 48  | (1996; R 2003) Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV                            |
| IEEE Std 81  | (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements |

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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

|               |   |
|---------------|---|
| NEMA C119.1   | (2006) Sealed Insulated Underground Connector Systems Rated 600 Volts   |
| NEMA C29.1    | (1988; R 2002) Test Methods for Electrical Power Insulators   |
| NEMA C80.1    | (2005) Standard for Electrical Rigid Steel Conduit (ERSC)   |
| NEMA FB 1     | (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable |
| NEMA LA 1     | (1992; R 1999) Standard for Surge Arresters   |
| NEMA TC 6 & 8 | (2003) Standard for Polyvinyl Chloride PVC Plastic Utilities Duct for Underground Installations                       |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

|         |  |
|---------|--|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
|---------|--|

UNDERWRITERS LABORATORIES (UL)

|              |  |
|--------------|--|
| UL 1242      | (2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel    |
| UL 467       | (2007) Standard for Grounding and Bonding Equipment                                      |
| UL 486A-486B | (2003; Rev thru Aug 2006) Standard for Wire Connectors                                   |
| UL 510       | (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape   |
| UL 514A      | (2004; Rev thru Aug 2007) Standard for Metallic Outlet Boxes                             |
| UL 6         | (2007) Standard for Electrical Rigid Metal Conduit-Steel                                 |
| UL 651       | (2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings |

1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall be as indicated.

- a. Altitude 1188 feet.



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b. Ambient Temperature Extreme Minimum = -6, Extreme Maximum = 112 degrees F.

c. Frequency 60 Hz

d. Seismic Parameters: Site Class D, Design Spectral Acceleration Parameters: SDS = 0.352, SDI = 0.131, Seismic Design Category: C.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Detail Drawings  
As-Built Drawings

Drawings, as specified.

#### SD-03 Product Data

Nameplates; G

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Requirements; G

As a minimum, installation procedures for transformers, substations, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

#### SD-06 Test Reports

Factory Tests

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

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### Field Testing

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

### Operating Tests

Six copies of the tests report in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

### Cable Installation

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with cable pulls numerically identified.
- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling tensions.
- f. The actual cable pulling tensions encountered during pull.

### SD-07 Certificates

#### Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be

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acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

#### Cable Joints

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

#### Installation Engineer

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

#### SD-10 Operation and Maintenance Data

##### Operation and Maintenance Manuals

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when

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warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

#### 1.4 QUALITY ASSURANCE

##### 1.4.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

1). Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

2). Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

3). Detail drawings shall, as a minimum, depict the installation of the following items:

(a). Medium-voltage cables and accessories including cable installation plan.

(b). Transformers.

(c). Substations.

(d). Switchgear.

(e). Pad-mounted loadbreak switches.

(f). Busways.

(g). Surge arresters.

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#### 1.4.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS 05.1. Handle wood poles in accordance with ATIS 05.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

#### 1.6 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCT

Provide material and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

#### 2.2 NAMEPLATES

##### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on

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a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

## 2.3 CORROSION PROTECTION

### 2.3.1 Aluminum Materials

Aluminum shall not be used.

### 2.3.2 Ferrous Metal Materials

#### 2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

#### 2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified below:

A. New Steel that has been hand or power tools cleaned to SSPC SP 2 or SSPC SP 3

#### 1. Alkyd

|                      |                                       |
|----------------------|---------------------------------------|
| New; MPI EXT 5.1Q-G5 | (Semigloss) Existing; MPI REX 5.1D-G5 |
| Primer:              | Intermediate: Topcoat:                |
| MPI 23               | MPI 94 MPI 94                         |
| System DFT:          | 5.25 mils                             |

B. New Steel that has been blast-cleaned to SSPC SP 6:

#### 1. Alkyd

|                      |                                       |
|----------------------|---------------------------------------|
| New; MPI EXT 5.1Q-G5 | (Semigloss) Existing; MPI REX 5.1D-G5 |
| Primer:              | Intermediate: Topcoat:                |
| MPI 79               | MPI 94 MPI 94                         |
| System DFT:          | 5.25 mils                             |

C. New Galvanized surfaces:

#### 1. Cementitious Primer / Latex

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MPI EXT 5.3A-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 26 MPI 11 MPI 11  
System DFT: 4.5 mils

2. Waterborne Primer / Latex  
MPI EXT 5.3H-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 134 MPI 11 MPI 11  
System DFT: 4.5 mils

## 2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

### 2.4.1 Medium-Voltage Cables

#### 2.4.1.1 General

Cable construction shall be concentric neutral underground distribution cable conforming to AEIC C8. Cables shall be manufactured for use in duct applications.

#### 2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

#### 2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

#### 2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of AEIC CS8. A 133 percent insulation level shall be used on 15 kV rated cables. Comply with EPA requirements in accordance with Section 01 67 00 RECYCLED / RECOVERED MATERIALS.

#### 2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper wire shield for each phase. The shield wire shall be sized to meet IEEE C2 requirements for a ground fault availability of 12.5 kA amperes.

#### 2.4.1.6 Neutrals

Concentric neutrals conductors shall be tinned copper, having a combined ampacity of 1/3 of the phase conductor ampacity rating for 3-phase circuits and full ampacity of the phase conductor ampacity rating for single phase circuits.

#### 2.4.1.7 Jackets

Cables shall be provided with a PVC jacket.

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#### 2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

##### 2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

##### 2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

##### 2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

##### 2.4.2.4 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

#### 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

##### 2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

##### 2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

##### 2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with insulated, solderless, pressure type connectors, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type



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connectors, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to NEMA C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

#### 2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

##### 2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

#### 2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines. Low-voltage lines or Communication lines run elsewhere may be direct-burial, thick-wall type except in vehicular traffic areas. All duct lines shall be concrete-encased, thin wall type in vehicular traffic areas.

##### 2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and NEMA C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

##### 2.6.2 Nonmetallic Ducts

###### 2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 & 8 Type EB.

###### 2.6.2.2 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 & 8 Type DB.

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### 2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

### 2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48/A 48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

### 2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

### 2.9 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

#### 2.9.1 Pad-Mounted Transformers

Pad-mounted transformer shall be provided by Central Issue Facility design-build.

#### 2.9.2 Pad-Mounted, Metal-Enclosed, Switchgear

The switchgear shall be configured with incoming compartments for loop-feed arrangement, equipped with air-insulated, load-interrupter switches, as indicated. The outgoing compartments shall be provided with fused disconnects, as indicated.

##### 2.9.2.1 Ratings at 60 Hz shall be:

- a. Nominal voltage (kV).....13.8.
- b. Rated maximum voltage (kV).....17.0.
- c. Rated continuous current (A).....As shown.

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- d. Maximum symmetrical interrupting capacity (kA).....12.5.
- e. Maximum asymmetrical interrupting capacity (kA).....22.4.
- f. Three-second short-time current-carrying capacity (kA)....12.5.
- g. BIL (kV).....95.

#### 2.9.2.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

- a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.
- b. Fused disconnects shall be hook-stick operated.

#### 2.9.2.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of IEEE C57.12.28 and IEEE C37.20.3, Category A.

### 2.10 METERING AND PROTECTIVE DEVICES

See Section 26 28 01.00 10.

### 2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

### 2.12 GROUNDING AND BONDING

#### 2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

#### 2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

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## 2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

## 2.14 PADLOCKS

Padlocks shall comply with ASTM F 883.

## 2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

### 2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

### 2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

### 2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

## 2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

b. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

c. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

d. Electrical Power Insulators: Manufacturer's standard tests in

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accordance with NEMA C29.1.

## 2.17 COORDINATED POWER SYSTEM PROTECTION

See Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 3.2 INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Steel conduits installed underground shall be installed and protected from corrosion. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

#### 3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

#### 3.2.2 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. Furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

### 3.3 CABLE INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then prepare a checklist of significant requirements and perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

#### 3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

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#### 3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

#### 3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

#### 3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

#### 3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

#### 3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.

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- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

### 3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.3.3 Direct-Burial

Direct burial of cables shall not be allowed.

### 3.3.4 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

## 3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

## 3.5 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

### 3.5.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering

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the joints of the first.

### 3.5.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

## 3.6 DUCT LINES

### 3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 48 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes. Provide rigid galvanized steel conduit factory elbows for horizontal bends and vertical bends.

### 3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any liquid or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

### 3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. Where ducts are jacked under existing pavement, rigid steel conduit shall



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be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

#### 3.6.4 Nonencased Direct-Burial

Top of duct lines shall not be less than 24 inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, a minimum of 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand hand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

#### 3.6.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

##### 3.6.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

#### 3.6.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 6 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels above such lines.

#### 3.7 MANHOLES, HANDHOLES, AND PULLBOXES

##### 3.7.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type

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noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 4 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

#### 3.7.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

#### 3.7.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

#### 3.7.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

#### 3.7.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 3 inches above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

#### 3.7.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above

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the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

### 3.8 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

#### 3.8.1 Concrete Pads

##### 3.8.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and be sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the equipment manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

##### 3.8.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

##### 3.8.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

#### 3.8.2 Padlocks

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed as directed by the Contracting Officer.

### 3.9 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized

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steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard. Pole installation shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

### 3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a switchgear ground bus to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

#### 3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed not less than 30 inches below finished top of soil grade. Ground ring conductors shall be #4/0 AWG, minimum.
- d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 12 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

#### 3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

#### 3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not

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permitted. Direct routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

#### 3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

#### 3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

#### 3.10.6 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

### 3.11 FIELD TESTING

#### 3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer 10 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

#### 3.11.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

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### 3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Multiple rod electrodes - 10 ohms.
- c. Ground ring - 10 ohms.

### 3.11.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the particular type of cable installed and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

### 3.11.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations of conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable in feet})$

Each cable failing this test shall be repaired or replaced. Each repaired cable shall be retested until failures have been eliminated.

### 3.11.6 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years

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of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

- a. Metal-enclosed switchgear
- b. Switches

#### 3.11.7 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted including the following:

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

#### 3.12 MANUFACTURER'S FIELD SERVICE

##### 3.12.1 Onsite Training

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

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### 3.12.2 Installation Engineer

After delivery of the equipment, furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

### 3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --





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SECTION 33 71 01

OVERHEAD TRANSMISSION AND DISTRIBUTION

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1 (2008) Specifications and Dimensions (for Wood Poles)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.14 (1979) Staples with Rolled or Slash Points for Overhead Line Construction

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 475 (2003) Standard Specification for Zinc-Coated Steel Wire Strand

ASTM A 575 (1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

ASTM A 576 (1990b; R 2006) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire

ASTM B 117 (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 2 (2008) Standard Specification for Medium-Hard-Drawn Copper Wire

ASTM B 232/B 232M (2001e1) Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)

ASTM B 3 (2001; R 2007) Standard Specification for

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Soft or Annealed Copper Wire

- ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D 1654 (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C135.1 (1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
- IEEE C135.2 (1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
- IEEE C135.22 (1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
- IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
- IEEE C37.42 (1996) High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse Links\*\*
- IEEE C62.11 (2005; Amendment A 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
- IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

- NETA ATS (2003) Acceptance Testing Specifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA C135.4 (1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
- NEMA C29.2 (1992; R 1999) Standard for Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
- NEMA C29.4 (1989; R 2002) Standard for Wet-Process Porcelain Insulators - Strain Type
- NEMA C29.5 (1984; R 2002) Wet-Process Porcelain Insulators (Low and Medium Voltage Pin

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Type)

NEMA C29.7

(1996; 2002) Standard for Wet Process  
Porcelain Insulators - High-Voltage Line  
Post Type

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2007; AMD 1 2008) National Electrical  
Code - 2008 Edition

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1

(2004) List of Materials Acceptable for  
Use on Systems of RUS Electrification  
Borrowers

RUS Bull 345-67

(1998) REA Specification for Filled  
Telephone Cables, PE-39

UNDERWRITERS LABORATORIES (UL)

UL 467

(2007) Standard for Grounding and Bonding  
Equipment

UL 486A-486B

(2003; Rev thru Aug 2006) Standard for  
Wire Connectors

UL 510

(2005; Rev thru Aug 2005) Polyvinyl  
Chloride, Polyethylene, and Rubber  
Insulating Tape

UL 6

(2007) Standard for Electrical Rigid Metal  
Conduit-Steel

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section  
with additions and modifications specified herein.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and  
electronics terms used in these specifications, and on the  
drawings, shall be as defined in IEEE Std 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;  
submittals not having a "G" designation are for Contractor Quality Control  
approval. When used, a designation following the "G" designation  
identifies the office that will review the submittal for the Government.  
The following shall be submitted in accordance with Section 01 33 00  
SUBMITTAL PROCEDURES:

SD-03 Product Data

Conductors

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Insulators; G

Wood Poles

Nameplates; G

Cutouts; G

Surge arresters; G

Guy strand

Anchors

SD-05 Design Data

SD-06 Test Reports

Wood Crossarm Inspection Report

Field Test Plan; G

Field Quality Control; G

Ground resistance test reports; G

Submit report of the acceptance test results as specified by paragraph entitled "Field Quality Control"

SD-07 Certificates

Wood poles; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 5; G

Submit operation and maintenance data as specified herein.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and IEEE C2 unless more stringent requirements are specified or indicated.

### 1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year

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period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

#### 1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.5.3 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

#### 1.5.4 Wood Crossarm Inspection Report

Furnish an inspection report from an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with applicable AWPA and RUS standards. The RUS approved Quality Mark "WQC" on each crossarm will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

##### 1.5.4.1 Field Test Plan

Provide a proposed field test plan 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

#### 1.6 MAINTENANCE

##### 1.6.1 Additions to Operations and Maintenance Data

In addition to requirements of Data Package 5, include the following in the operation and maintenance manuals provided:

- a. Assembly and installation drawings
- b. Prices for spare parts and supply list
- c. Date of purchase

#### 1.7 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when

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received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS 05.1. Handling of wood poles shall be in accordance with ATIS 05.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used. Nails and holes are not permitted in top of poles.

#### 1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements. Equipment and component items, not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The described test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

#### 2.2 POLES

Poles shall be of lengths and classes indicated.

##### 2.2.1 Wood Poles

Wood poles machine trimmed by turning, Southern Yellow Pine conforming to ATIS 05.1 and RUS Bull 345-67. Gain, bore and roof poles before treatment. Should additional gains be required subsequent to treatment, metal gain plates shall be provided. Pressure treat poles with pentachlorophenol. The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

##### 2.2.2 Ground Wire

Provide full height #4 copper ground wire and butt coil at the base of each new pole.

#### 2.3 CROSSARMS AND BRACKETS

##### 2.3.1 Crossarm Braces

Provide flat steel or steel angle as indicated. Provide braces with 60 inch span for 10 foot crossarms.

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### 2.3.2 Armless Construction

Pole mounting brackets for line-post or pin insulators and eye bolts for suspension insulators shall be as shown. Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to IEEE C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 2800 pound cantilever strength.

### 2.4 HARDWARE

Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

Zinc-coated hardware shall comply with IEEE C135.1, IEEE C135.2, NEMA C135.4, ANSI C135.14 IEEE C135.22. Steel hardware shall comply with ASTM A 575 and ASTM A 576. Pole-line hardware shall be hot-dip galvanized steel, except anchor rods of the copper-molten welded-to-steel type with nonferrous corrosion-resistant fittings shall be used. Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

### 2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

- a. Line post type insulators: NEMA C29.7, Class 57.1L.
- b. Suspension insulators: NEMA C29.2, Quantity per Phase, 2, Class 52-9.
- c. Guy strain insulators: NEMA C29.4, Class 54-2, except provide fiberglass type when used with underground terminal or when other interference problems exist.
- d. Pin insulators: NEMA C29.5, Class 55-3.

### 2.6 OVERHEAD CONDUCTORS, CONNECTORS AND SPLICES

Conductors of bare copper and aluminum conductor steel reinforced (ACSR) of sizes and types indicated. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.

#### 2.6.1 Solid Copper

ASTM B 1, ASTM B 2, and ASTM B 3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B 8, stranded.



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## 2.6.2 Aluminum Conductor Steel Reinforced (ACSR)

ASTM B 232/B 232M, aluminum.

## 2.6.3 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition, aluminum-composition to copper, and copper-to-copper shall comply with UL 486A-486B.

## 2.7 GUY STRAND

ASTM A 475, extra high-strength, Class A or B, galvanized strand steel cable. Guy strand shall be 0.519 inch in diameter with a minimum breaking strength of 25,000 pounds. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

## 2.8 ROUND GUY MARKERS

Vinyl or PVC material, yellow colored, 8 feet long and shatter resistant at sub-zero temperatures.

### 2.8.1 Guy Attachment

Thimble eye guy attachment.

## 2.9 ANCHORS AND ANCHOR RODS

Anchors shall present holding area indicated on drawings as a minimum. Anchor rods shall be triple thimble-eye, one inch diameter by 8 feet long. Anchors and anchor rods shall be hot dip galvanized.

### 2.9.1 Plate Anchors

Minimum area of 400 square inches and rated by manufacturer for 24,000 pounds or more in soils classified as medium dense coarse sand and sandy gravels; firm to stiff clays and silts.

## 2.10 GROUNDING AND BONDING

### 2.10.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

### 2.10.2 Grounding Conductors

ASTM B 8. Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors shall be PVC.

### 2.10.3 Grounding Connections

UL 467. Exothermic weld or compression connector. All underground connections shall be exothermically welded.

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## 2.11 SURGE ARRESTERS

IEEE C62.11, metal oxide, polymeric-housed, surge arresters arranged for crossarm mounting. RMS voltage rating shall be 10 kV. Arresters shall be Distribution class.

## 2.12 FUSED CUTOUTS

Open type fused cutouts rated 200 amperes and 11,500 amperes symmetrical interrupting current at 8.3/15 kV gnd Y, conforming to IEEE C37.42. Type K fuses conforming to IEEE C37.42 with ampere ratings as indicated. Open link type fuse cutouts are not acceptable.

## 2.13 CONDUIT RISERS AND CONDUCTORS

The riser shield shall be PVC containing a PVC back plate and PVC extension shield or a rigid galvanized steel conduit, as indicated, and conforming to UL 6. Provide conductors and terminations as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

## 2.14 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

## 2.15 CAULKING COMPOUND

Compound for sealing of conduit risers shall be of a puttylike consistency workable with hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. Compound shall readily caulk or adhere to clean surfaces of the materials with which it is designed to be used. Compound shall have no injurious effects upon the workmen or upon the materials.

## 2.16 NAMEPLATES

### 2.16.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Equipment containing liquid-dielectrics shall have the type of dielectric on the nameplate.

### 2.16.2 Field Fabricated Nameplates

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

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### PART 3 EXECUTION

#### 3.1 INSTALLATION

Provide overhead pole line installation conforming to requirements of IEEE C2 for Grade B construction of overhead lines in heavy loading districts and NFPA 70 for overhead services. Provide material required to make connections into existing system and perform excavating, backfilling, and other incidental labor. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated.

##### 3.1.1 Wood Pole Installation

Provide pole holes at least as large at the top as at the bottom and large enough to provide 4 inch clearance between the pole and side of the hole.

##### 3.1.1.1 Setting Depth of Pole

Pole setting depths shall be as follows:

| Length of Pole<br>(feet) | Setting in Soil<br>(feet) | Setting in Solid Rock<br>(feet) |
|--------------------------|---------------------------|---------------------------------|
| 20                       | 5.0                       | 3.0                             |
| 25                       | 5.5                       | 3.5                             |
| 30                       | 5.5                       | 3.5                             |
| 35                       | 6.0                       | 4.0                             |
| 40                       | 6.0                       | 4.0                             |
| 45                       | 6.5                       | 4.5                             |
| 50                       | 7.0                       | 4.5                             |
| 55                       | 7.5                       | 5.0                             |
| 60                       | 8.0                       | 5.0                             |
| 65                       | 8.5                       | 5.5                             |
| 70                       | 9.0                       | 5.5                             |
| 75                       | 9.5                       | 6.0                             |
| 80                       | 10.0                      | 6.0                             |
| 85                       | 10.5                      | 6.5                             |
| 90                       | 11.0                      | 6.5                             |
| 95                       | 11.5                      | 7.0                             |
| 100                      | 12.5                      | 7.5                             |

##### 3.1.1.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

- a. Where pole holes are in soil, sand, or gravel or any combination of these;
- b. Where soil layer over solid rock is more than 2 feet deep;
- c. Where hole in solid rock is not substantially vertical; or
- d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level. At corners, dead ends and other points of extra strain, poles 40 feet or more long shall be set 6 inches deeper.

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#### 3.1.1.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

#### 3.1.1.4 Setting With Soil Over Solid Rock

Where a layer of soil 2 feet or less in depth over solid rock exists, depth of hole shall be depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth shall not exceed depth specified under "Setting in Soil."

#### 3.1.1.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

#### 3.1.1.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

#### 3.1.1.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

#### 3.1.1.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top. Holes shall be dug large enough to permit the proper use of tampers to full depth of hole.

#### 3.1.1.9 Pole Caps

Provide plastic pole caps with 1/4 inch sealing rings and four nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with a 1 1/4 inch nail.

#### 3.1.2 Anchors and Guys

Place anchors in line with strain. The length of the guy lead (distance from base of pole to the top of the anchor rod) shall be as indicated.

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#### 3.1.2.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

#### 3.1.2.2 Backfilling Near Plate Anchors

Backfill plate, expanding, concrete, or cone type anchors with tightly tamped coarse rock 2 feet immediately above anchor and then with tightly tamped earth filling remainder of hole.

#### 3.1.2.3 Guy Installation

Provide guys where indicated, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners and dead-ends. Where single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided. Provide pole shims where guy tension exceeds 6000 pounds. Guy clamps 6 inches in length with three 5/8 inch bolts, or offset-type guy clamps, or approved guy grips shall be provided at each guy terminal. Securely clamp plastic guy marker to the guy or anchor at the bottom and top of marker. Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section. Provide strain insulators at a point on guy strand 8 feet minimum from the ground and 6 feet minimum from the surface of pole. Effectively ground and bond guys to the system neutral.

#### 3.1.3 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts shall be M-F style and not palnut style.

#### 3.1.4 Grounding

Unless otherwise indicated, grounding shall conform to IEEE C2 and NFPA 70.

##### 3.1.4.1 Grounding Electrode Installation

Grounding electrodes shall be installed as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately 3 feet out from base of the pole and shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade. Multiple rods shall be evenly spaced at least 10 feet apart and connected together 2 feet below grade with a minimum No. 6 bare copper conductor.
- b. Ground resistance - The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 12 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms

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measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

#### 3.1.4.2 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Neutrals, surge arresters, and equipment grounding conductors shall be bonded to this conductor. For single-grounded or ungrounded systems, provide a grounding electrode conductor for the surge arrester and equipment grounding conductors and a separate grounding electrode conductor for the secondary neutrals. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet. Grounding electrode conductors shall be sized as indicated. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor as indicated. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

#### 3.1.4.3 Grounding Electrode Connections

Make above grade grounding connections on pole lines by exothermic weld or by using a compression connector. Make below grade grounding connections by exothermic weld. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method shall provide visible indication that a connector has been fully compressed on ground wire.

#### 3.1.4.4 Grounding and Grounded Connections

- a. Where no primary or common neutral exists, surge arresters and frames of equipment operating at over 750 volts shall be bonded together and connected to a dedicated primary grounding electrode.
- b. When a primary or common neutral exists, connect all grounding and grounded conductors to a common grounding electrode.

#### 3.1.4.5 Protective Molding

Protect grounding conductors which are run on surface of wood poles by PVC molding extending from ground line to minimum 8 feet above ground line.

#### 3.1.5 CONDUCTOR INSTALLATION

##### 3.1.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Conductors shall be handled with care necessary to prevent nicking, kinking, gouging, abrasions, sharp bends, cuts, flattening, or otherwise deforming or weakening conductor or any damage to insulation or impairing its conductivity. Remove damaged sections of conductor and splice conductor. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method

unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.1.5.2 Connectors and Splices

Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No splice shall be permitted within 10 feet of a support. Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.1.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as specified in TABLE I.

| TABLE I                   |                                     |
|---------------------------|-------------------------------------|
| TIE-WIRE REQUIREMENTS     |                                     |
| CONDUCTOR<br>Copper (AWG) | TIE WIRE<br>Soft-Drawn Copper (AWG) |
| 6                         | 8                                   |
| 4 and 2                   | 6                                   |
| 1 through 3/0             | 4                                   |
| 4/0 and larger            | 2                                   |
| AAC, AAAC, or ACSR (AWG)  | AAAC OR AAC (AWG)                   |
| Any size                  | 6 or 4                              |

3.1.5.4 Armor Rods

Armor rods shall be provided for ACSR conductors. Armor rods shall be installed at supports, except armor rods will not be required at primary

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dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods shall be used.

#### 3.1.5.5 Ties

Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

#### 3.1.5.6 Reinstalling Conductors

Existing conductors to be reinstalled or resagged shall be strung to "final" sag table values indicated for the particular conductor type and size involved.

#### 3.1.5.7 New Conductor Installation

String new conductors to "initial" sag table values indicated for conductor type and size of conductor and ruling span indicated.

#### 3.1.5.8 Fittings

Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

#### 3.1.5.9 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

#### 3.1.6 Risers

Secure galvanized steel conduits on poles by two hole galvanized steel pipe straps spaced as indicated and within 3 feet of any outlet or termination. Ground metallic conduits.

### 3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

### 3.3 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.



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### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

#### 3.4.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.4.3 Sag and Tension Test

The Contracting Officer shall be given prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits and reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

#### 3.4.4 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

##### 3.4.4.1 Grounding System

###### a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

###### b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

#### 3.4.5 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three

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times, demonstrating satisfactory operation each time.

#### 3.4.6 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --